BASIN DESCRIPTION

Area Overview

The South Fork Snake River Basin encompasses all land draining into the South Fork Snake River from the Idaho-Wyoming state line to the confluence with the Henrys Fork (Figure 1). Technically the South Fork Snake River is not a fork, but the main stem of the Snake River as indicated on U.S. Geological Survey maps. The South Fork Snake is the name commonly used by many people and is used in this plan. The South Fork Snake River originates in Yellowstone National Park. The headwater tributaries originate in the Teton, Gros Ventre, and Salt River mountains located in Wyoming.

Water flow of the South Fork Snake River is regulated by Palisades and Jackson Lake dams. Jackson Lake is in Grand Teton National Park, Wyoming. The portion of Palisades Reservoir located in Idaho defines the upstream boundary of the Board's South Fork Snake River Basin. Storage and releases from Jackson and Palisades reservoirs are coordinated with operation of five other Snake River storage reservoirs located above Milner Dam. The Upper Snake River Reservoir System is operated as a unit by the U.S. Bureau of Reclamation (USBR). Water rights are under the administrative control of the Director of the Idaho Department of Water Resources (IDWR) through the watermaster of Water District 01. Water is stored and distributed according to the water right priorities that have been established for Snake River water. While there are water rights on many of the tributary streams, most of the tributaries in the basin do not have storage impoundments.

Agriculture is a predominant industry in the basin. Dryland and irrigated farming are practiced in the area. Agricultural products include winter wheat, rapeseed, spring barley, potatoes, and alfalfa. Dryland farming mainly occurs upstream of Heise on benches above the river. The most significant diversions from the river for irrigation occur below Heise.

The basin possesses many outstanding natural resource values. The South Fork Snake River is a nationally renowned trout fishery supporting two varieties of cutthroat trout and brown trout. The cottonwood riparian complex bordering the river is considered one of "the most extensive and highest quality" in Idaho (U. S. Department of Interior, Fish and Wildlife Service, 1980). The river corridor is also critical bald eagle habitat supporting 37 percent of Idaho's nesting population, and half of the state's production (U. S. Department of Interior, Bureau of Land Management and U. S. Department of Agriculture, Forest Service [BLM and Forest Service], 1991). Outstanding scenery, a quality fishery, and wildlife values provide diverse recreation opportunities.

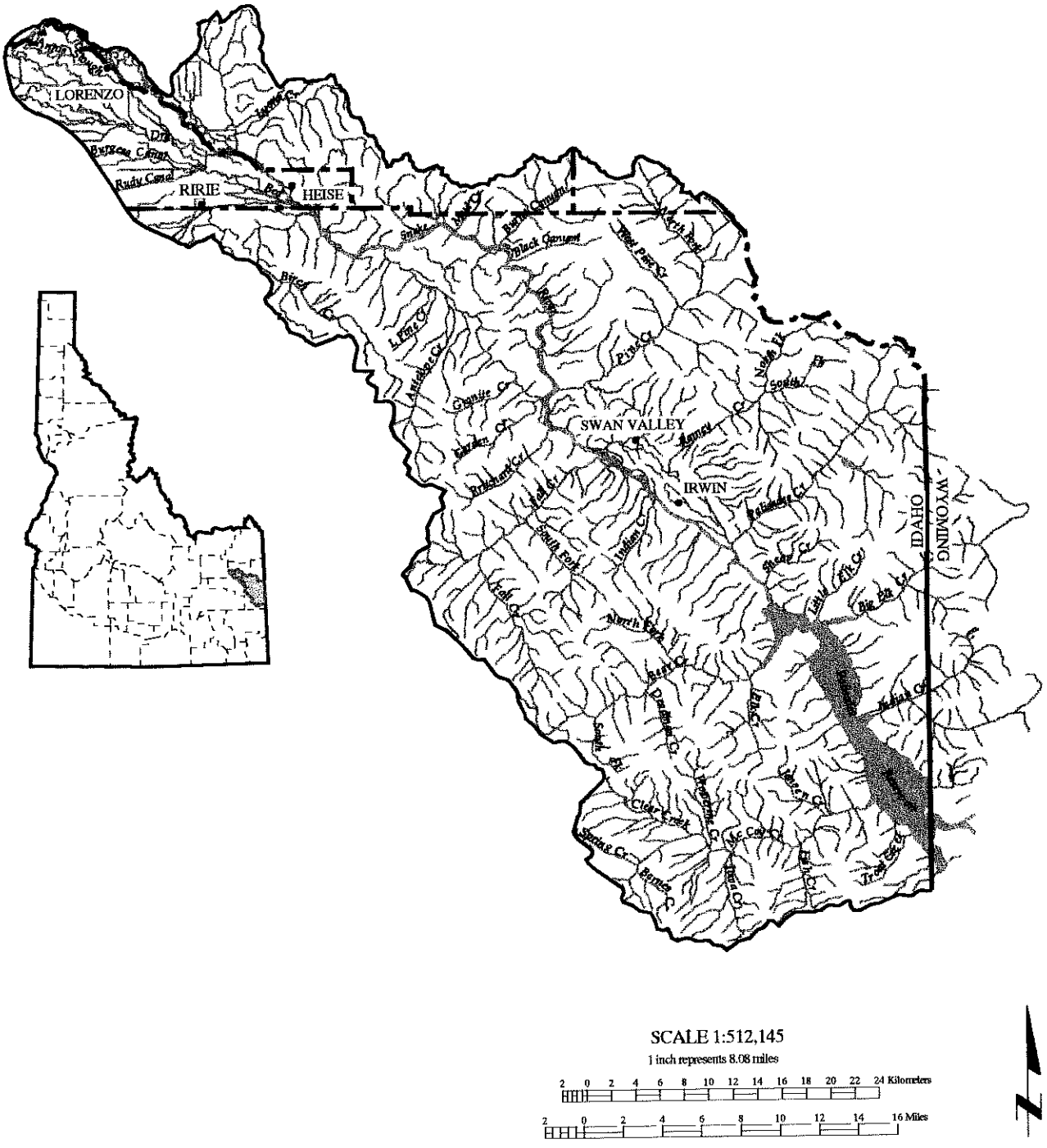
GEOLOGY AND SOILS

The basin straddles two physiographic provinces. The eastern portion encompasses the Middle Rocky Mountain province and the western half contains the eastern edge of the Snake River Plain province. The Middle Rocky Mountain province is characterized by the heavily forested Yellowstone Plateau of volcanic origin, and complexly folded and faulted ranges.

The Snake River, Big Hole and Caribou mountain ranges in the basin illustrate the folding and faulting processes that formed the Rocky Mountains. Rocks of Paleozoic and Mesozoic sedimentary formations moved along the thrust faults in Cretaceous time about 70 to 90 million years ago (Alt and Hyndman, 1989). The Caribou Range is composed of rocks from Mesozoic formations deposited during Triassic and Jurassic time. The Snake River range is an older formation deposited during Paleozoic time. The Big Hole range contains formations from Mesozoic and Paleozoic eras.

Figure 1

Water Resources



The ranges along the Idaho-Wyoming border are commonly referred to as the Idaho-Wyoming thrust belt. The belt is a part of the North American Cordillera, a chain composed of numerous mountain ranges extending from Alaska into Mexico. Faults were formed by the compression of the earth's shallow crust from west to east, causing the sheets to override each other. The older western plate overlies the younger rocks, deviating from expected sequences. Streams later cut valleys through the thrust plates. The eastern edge of the Basin and Range faults are beginning to alter the mountains in the overthrust belt (Alt and Hyndman, 1989). The Grand and Swan valleys are in a dropped Basin and Range fault block carved into the overthrust belt.

The eastern edge of the Snake River Plain physiographic province flanks the Caribou and Snake River ranges on the west. The Snake River Plain is a lava-filled basin formed by the eruption of rhyolite volcanoes that became extinct as the hot spot moved northeastward, currently located at Yellowstone (Alt and Hyndman, 1989). Stretching of the earth's crust followed along the Basin and Range faults, causing basalt to flow and cover the rhyolite.

Menan Buttes, located at the confluence of the South Fork Snake River and Henrys Fork, is at the edge of the Rexburg caldera. The buttes are composed of basaltic glass, formed by quick chilling of the magma as it erupted in the saturated alluvium of the Snake River Valley. The glassy tuff cones are found in only a few places in the world, leading to designation as a National Natural Landmark. National Natural Landmarks are "sites determined to be one of the best examples of a natural region's characteristic biotic or geologic features" (U. S. Department of Interior, National Park Service, 1987).

Soils located in the South Fork Snake River floodplain above Heise comprise the Hobacker-Badgerton Variant-Typic Cryaquolls unit (USDA Soil Conservation Service [SCS], 1981a). Soils are very deep from 30-32 inches, located on nearly level to moderately steep slopes, and well-drained to poorly drained. Hobacker series soils are formed in alluvium derived material, mainly sedimentary rock and quartzite. Badgerton Variant soils are found on river terraces and alluvial fans, forming in mixed alluvium. Typic Cryaquolls have high water tables (at a depth of 12 to 24 inches) during the growing season.

Soils on the Pine Bench and on loess foothills and mountainsides in the Swan Valley area consist of the Tetonia-Rin-Ririe unit (SCS, 1981a). These soils are very deep and well-drained. The soils are classified as silt loams.

Below Heise, soils adjacent to the South Fork Snake River include the Hayeston-Heiseton-Blackfoot units on the south, and the Labenzo-Blackfoot and Bannock-Bockston-Wardboro on the north (SCS, 1979 and 1981b). Hayeston-Heiseton-Blackfoot units are located on river terraces and lake beds. They are characterized by moderately, well-drained to well-drained soils (SCS, 1979). Labenzo-Blackfoot soils are found on river terraces and floodplains, and are somewhat poorly to moderately, well-drained (SCS, 1981b). Bannock-Bockston-Wardboro soils are well-drained and sometimes excessively drained, and located on river terraces. (Excessively drained soils remove water from the soil rapidly.)

CLIMATE

The climate in the basin is influenced by air masses from the Pacific Northwest, Gulf of Mexico and Central Canada. The basin has a semiarid climate with cool, moist winters, and warm, dry summers. The average annual precipitation ranges from 12-15 inches on the Snake River Plain, 20 inches in the Swan Valley area, to over 26 inches in higher elevations (Molnau, 1993). Variations are caused primarily by topographic relief. Snowpacks of 60 to 70 inches are common in the mountains. Mean annual air temperature is 42 degrees F. Frost free days range from 60-70 in the eastern portion of the basin to 105 days in the western portion (SCS, 1979; 1981a; and 1981b).

LAND OWNERSHIP AND USE

Over 67 percent of the basin is managed by several federal agencies including the Targhee and Caribou national forests, Idaho Falls District Bureau of Land Management (BLM) and the U.S. Bureau of Reclamation (USBR). Approximately 1 percent are state endowment lands, and the remaining 28 percent is privately owned. Table 1 lists acreage by ownership. Figure 2 illustrates land ownership patterns. Mixed land ownership occurs along the river, consisting mainly of land managed by the BLM and Targhee National Forest, with private and some state lands.

The South Fork Snake River reach is characterized by four landscape settings. The upper reach contains Palisades Reservoir. The reservoir was constructed to provide irrigation storage, flood protection, hydropower production, and fish and wildlife benefits. Developed recreation facilities are located around the perimeter (Figure 17, page 57). Residences occur on private land parcels located on the north side tributaries to the reservoir.

Foothills and forested mountains enclose the river valley from Palisades Dam to Conant Valley. National Forest lands and associated recreation development border the south side of the river, and some homes are being developed on the private land. Private lands and a few parcels managed by the BLM occur on the north. Farmlands and pastures occur in the valley and on benches above the river. Limited commercial activity occurs at Swan Valley, located at the intersections of Highway 26 and 31, and in Irwin along Highway 26. Residential and second home development is increasing.

From Conant Valley to above Heise the river flows through a deep rhyolite canyon. The upper portion of the canyon is unroaded. The lower portion is paralleled by an unpaved road on the east. Land ownership is predominately Forest Service and BLM with a few private parcels. The lands above the canyon are privately owned and used for dryland farming. Some of these lands have been platted for subdivisions. A few of the private parcels along the river have residential development.

Table 1. Ownership Within the South Fork Snake River Basin, Idaho.

	Acres
U.S. Forest Service	413,963
U.S. Bureau of Land Management	10,548
U.S. Bureau of Reclamation (withdrawals)	11,242
Idaho Department of Lands	7,930
Private	183,220
Water	18,072
TOTAL	644,975

Below Heise the river enters a broad, open floodplain and is characterized by extensive braiding. Land ownership consists of private and BLM lands. Irrigated farming and grazing are the principal land uses. Figure 3 depicts the land uses in the basin.

BASIN HISTORY

Prehistory

Human occupation has been documented for the past 9,000-10,000 years in the basin (McDonald, 1983; BLM and Forest Service, 1991). The earliest inhabitants were from the pre-Shoshonean period (Willingham, 1993). Early inhabitants were thought to be small, highly mobile bands which hunted big game (Butler, 1986).

As the climate became more arid, many species of big game disappeared (Butler, 1986; McDonald, 1983). Native societies shifted from specialized big game hunting to a more generalized hunting and gathering way of life. These societies developed seasonal, migratory routes to camas fields, fishing waters and other food gathering areas, utilizing natural routes along rivers and mountain passes. The Conant Pass was used to travel to winter camps to the west. In the spring the Fall Creek drainage was used to travel to Jackson Hole (McDonald, 1983).

Figure 2

Land Ownership

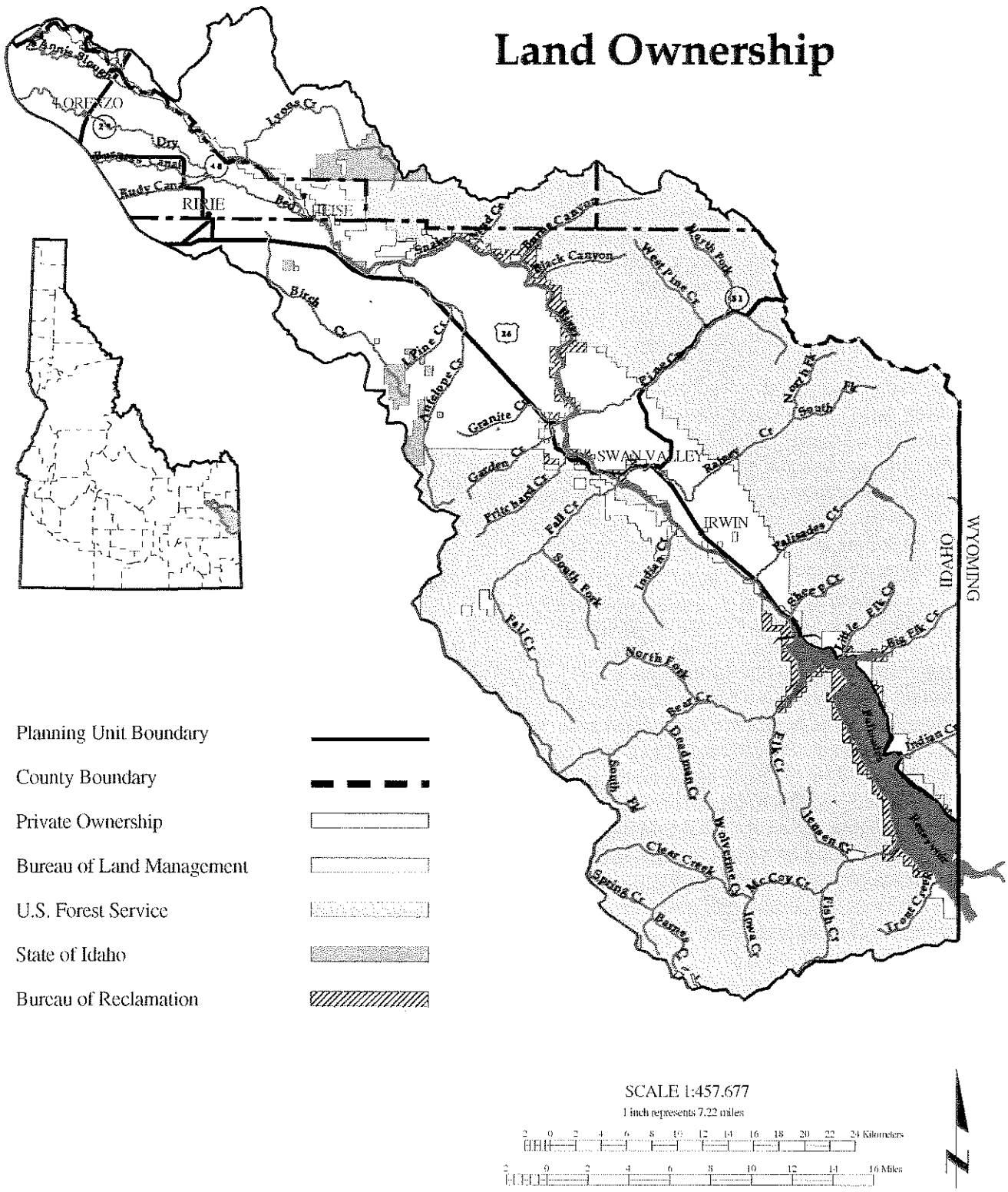
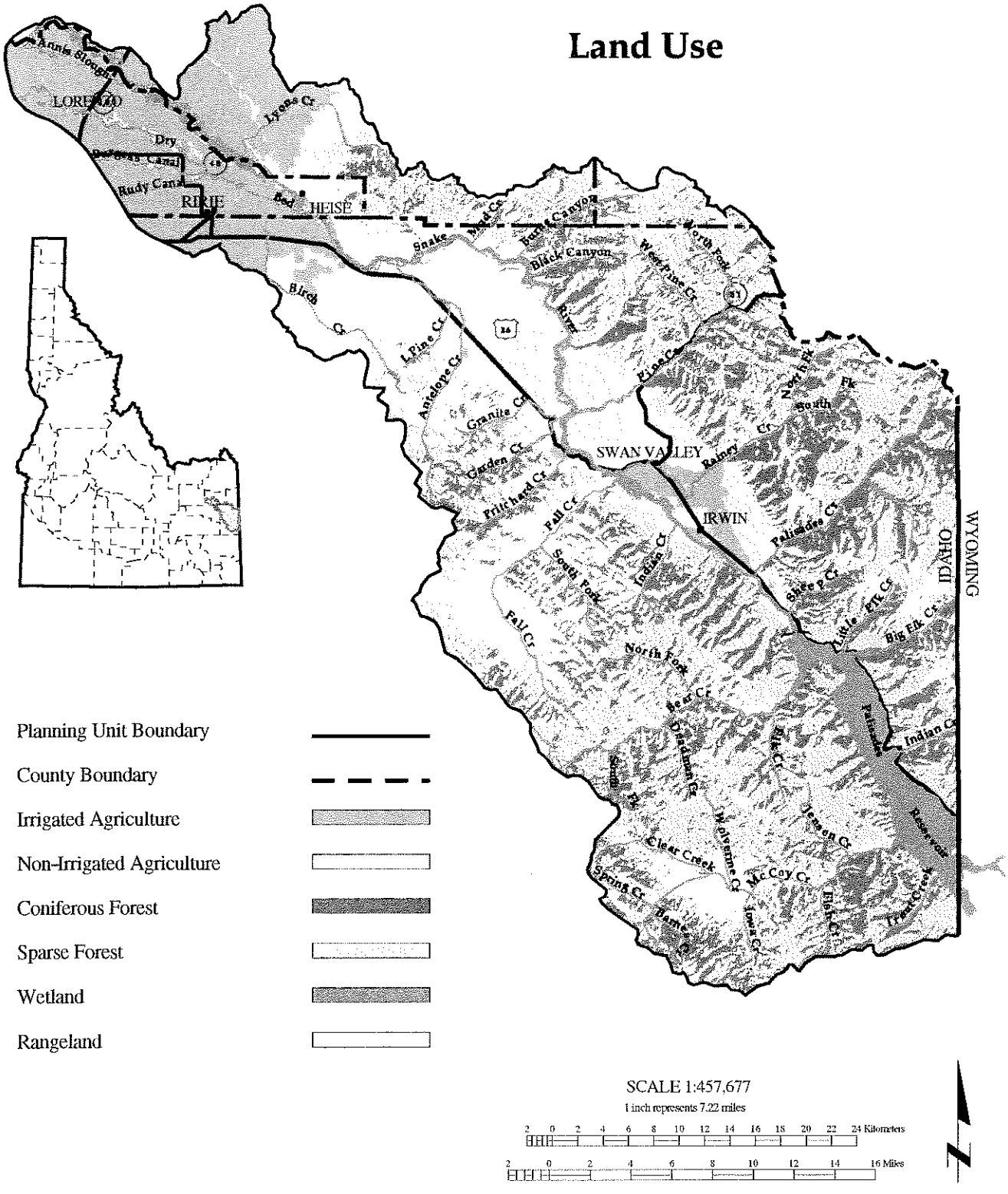


Figure 3

Land Use



The Shoshone are known to have occupied the area for the past 650 years (BLM and Forest Service, 1991). The Shoshone people expanded into the area from the Great Basin, outcompeting and displacing the indigenous population (McDonald, 1983). The Bannocks arrived afterwards, migrating from the Idaho-Oregon border following their acquisition of the horse (sometime in the early-1700's) (McDonald, 1983). By the nineteenth century, the Bannock and Shoshone were culturally identical (Liljeblad, 1957).

The horse changed the Shoshone-Bannock culture, allowing increased mobility to pursue bison and other food sources. In the winter, the people resided in the lower elevations along rivers. In the spring, they would hunt game in the mountains and gather plant materials. Fall hunting parties traveled from Camas Prairie to Jackson Hole and Yellowstone along the South Fork Snake River to pursue elk (McDonald, 1983). These parties traveled above the South Fork Snake canyon (Butler, 1958).

The South Fork Snake River Basin is part of the traditional home territory of the Shoshone-Bannock Tribes. The basin and surrounding lands have spiritual significance to the Tribes, and historically have been used for hunting, fishing and gathering activities. The Fort Bridger Treaty of 1868 secures the right of the Tribes to hunt and fish ". . .on the unoccupied lands of the United States." This includes lands under the jurisdiction of the Forest Service, BLM and USBR in the South Fork Snake River Basin. The American Indian Religious Freedom Act of 1978 and other federal laws preserve the right to believe, express and exercise traditional religions. This would include access to sites in the basin, possession of sacred objects, and practice of traditional rites and ceremonies.

History

An abundance of fur bearing animals along the Snake River and tributaries attracted trappers, the first Euro-American men, in the early 1800's. Major Indian tribes in the basin at the time included the Shoshone, Bannock, Blackfoot, and Crow (BLM and Forest Service, 1991). The basin and surrounding lands were the site of much activity from 1810 to 1840 as various fur trade companies competed for domination in the area. Rendezvouses occurred every year with trappers and Indians to celebrate and trade. One gathering spot, Pierce's Hole, located just north of the basin between Victor and Driggs is remembered for a battle that occurred between the trappers and Blackfeet Tribe in 1832 (Clements, 1974). Pine Creek drainage was one of the travel routes to Pierce's Hole (Willingham, 1993). While a few independent trappers remained, by the late 1830's and 1840's the fur companies were no longer prevalent in the territory because the price for beaver furs had dropped and the animal populations were sparse.

Settlement of the area by Euro-Americans began in the 1870's attracted by farming, ranching, logging and mining opportunities. White emigration with the discovery of gold and agricultural settlement led to conflicts with the Shoshone and Bannock peoples. Wintering grounds were occupied by the settlements, and fish and game were depleted by the miners, disrupting significant components of the Shoshone and Bannock cultures. Several conflicts occurred resulting in the establishment of the Fort Hall Indian Reservation in 1867 and the signing of the Fort Bridger Treaty of 1868 (McDonald, 1983).

Gold was discovered in the Caribou Mountains (called Mount Pisgah at the time) in 1870. Fifteen years of placer mining followed. Lode claims were discovered in 1874 and pursued for more than a decade. During this gold rush, two settlements were established -- Keenan City and Caribou City. Keenan City was the first town in Bonneville County, having a population of 500 and a Chinese community of several hundred (Sparling, 1974). In 1885 Caribou City was populated by 1500 people. The town burned that year and was never rebuilt (Sparling, 1974).

Many people migrated from Utah and the eastern United States to settle in the basin and adjoining Snake River Valley from a period of mid-1870's through the early 1900's. Much of

the colonization was the result of organized efforts by Mormon colonists from Utah (Beal, 1942). During this period, many pioneers organized irrigation companies to divert water from the South Fork Snake River. One of the oldest settlements in the Snake River country is present day Menan, originally named Poole's Island. While employed with Utah Northern Railroad, John Poole of Ogden explored the area and decided to homestead (Carter, 1955). Poole developed one of the first irrigation canals, the Long Island Canal, in 1880 to bring South Fork Snake River water from the Dry Bed to the island.

Numerous canals were constructed during this period by local, cooperative irrigation companies. Many of the projects diverted water from a branch of the river commonly referred to as the Dry Bed. The South Fork Snake River was constantly changing, leaving inadequate flow in the Dry Bed to meet the demand. To rectify the situation, the canal companies dependent on this channel of the river organized to construct the Great Feeder. The canal was completed in 1895 (Carter, 1955).

The Reclamation Act of 1902 provided an opportunity to get federal assistance in storing water for late season irrigation and controlling floods. Several federal projects on the Upper Snake River were constructed upstream and downstream of the South Fork Snake River Basin. The Reclamation Project Act of 1939 resulted in authorization of Palisades Dam with re-authorization in 1950. The project was completed in 1957.

POPULATION AND ECONOMICS

Population

Estimated population for the South Fork Snake River Basin and surrounding rural area (including Rigby) is about 7,205 based on 1990 U.S. Census data. Most of the basin is located within Bonneville County with small portions of Jefferson and Madison counties. The projected population growth for these counties is shown in Table 2.

Population information is available for a few of the communities within the basin. The communities of Ririe and Swan Valley experienced a population increase while Irwin experienced a decrease between 1980 and 1990 (Table 3). By comparison, Bonneville County experienced a 9.4 percent growth, Jefferson County an 8.1 percent increase, and Madison County a 21.5 percent increase (Table 4).

Table 2. Population and Projections for Bonneville, Jefferson and Madison Counties.

Population	1980	1990	1995	2000	2005	2010	2015
Bonneville	65,980	72,207	81,112	88,720	93,510	99,380	105,490
Jefferson	15,304	16,543	18,869	21,110	22,700	24,420	26,150
Madison	19,480	23,674	24,312	29,570	32,180	34,690	37,160

Source: Idaho Power Company, 1994; Idaho Department of Commerce, 1994; Idaho Department of Employment, 1995a.

Table 3. Population for Some Communities in the South Fork Snake River Basin.

Community	1980	1990	Percent Change
Irwin	113	108	-4.4
Ririe	555	596	7.4
Swan Valley	135	141	4.4

Source: U. S. Census, 1990.

Table 4. Percent Population Change in Bonneville, Jefferson and Madison Counties.

County	1970-1980	1980-1990	1990-1995	Annual Average 1990-1995	Annual Average 1995-2015
Bonneville	25.8	9.4	12.3	2.4	1.3
Jefferson	30.4	8.1	14.1	2.7	1.6
Madison	44.8	21.5	2.7	0.5	2.1
State of Idaho	32.4	6.6	15.2	2.9	
United States	11.1	9.7	5.1	1.0	

Source: Idaho Department of Commerce, 1994; Idaho Department of Employment, 1995a; Idaho Power Company, 1994; U.S. Bureau of the Census, 1993.

From 1990 to 1995 the population has increased at an annual average rate of 2.4 percent in Bonneville County, 2.7 percent in Jefferson County, and 0.5 percent in Madison County.

The population in southeastern Idaho is projected to continue increasing at an annual average rate of 1.3 to 2.1 percent for the next 20 years. The population of Bonneville County is projected to increase 30 percent by the year 2015 (Table 2). All communities in the basin are expected to see increases in population and dwellings in the future as development pressures continue. A portion of this development is expected to include second homes. The 1990 census identified 429 second homes in the Swan Valley division. These projections foretell increased residential growth, resulting in increased demands for the resources of the South Fork Snake River Basin including public services and outdoor recreation opportunities.

Employment and Income

Agriculture represents one of the primary industries in the three county area, with manufacturing, atomic energy research, and recreational travel also significant contributors. Much of the manufacturing is the processing and production of potato and dairy products, cement products, farm equipment, and foundry products (Idaho Department of Employment, 1995b). Employment and personal income by industry for the three counties in the South Fork Snake River Basin are listed in Tables 5 and 6. Employment by industry for the South Fork Snake River Basin is shown in Table 7 based on 1990 U. S. Census data.

Bonneville County relies heavily on the service sector for its economic base with the Idaho National Engineering and Environmental Laboratory employing the largest portion of the service sector. Retail trade accounts for the second largest group of workers. Jefferson County, like other counties in the area, has many people employed in the agriculture and food processing industries. Madison County, although rural, functions as a diversified trade and service center due to the influence of Ricks College. For the basin and surrounding area, retail and educational services are the largest employers for area residents (Table 7).

As in any economy, employment growth is not uniform. Some industries have experienced strong growth, some remain unchanged, and some have experienced declines in employment (Table 5). Farm employment has declined in all three counties from 1980 to 1992 -- 36 percent in Bonneville, 27 percent in Jefferson, and 30 percent in Madison, resulting in a loss of 1451 jobs. Productivity gains through the use of more efficient machinery contributed to the loss of jobs. Many agricultural producers have cited the cost of labor and an overall shortage of labor as a factor in their decision to move to automated technologies (Idaho Power Company, 1994). While farm employment has experienced declines, employment in agricultural services, forestry and fisheries has doubled.

Table 5. Employment Statistics for Bonneville, Jefferson and Madison Counties.

Employment by Industry	1980	1984	1988	1992	% Change
BONNEVILLE COUNTY					
Farm	1,971	1,767	1,385	1,252	-36.48
Ag. Serv., Forest, Fish.	261	362	589	547	109.58
Manufacturing	1,847	1,903	1,776	2,404	30.16
Mining	59	93	79	27	-54.24
Construction	2,626	2,360	2,347	2,914	10.97
Transport. Com.& Util.	1,214	1,042	1,040	1,199	-1.24
Wholesale Trade	2,534	2,621	2,659	3,160	24.70
Retail Trade	5,442	6,304	7,681	8,852	62.66
Finance, Ins. & Real Estate	1,925	1,885	2,353	2,380	23.64
Services	9,506	9,757	10,889	13,866	45.87
Federal Civilian	819	743	704	924	12.82
Federal Military	539	415	533	504	-6.49
State & Local Government	2,918	2,877	3,307	3,925	34.51
Total Employment	31,661	32,129	35,378	41,954	32.51
JEFFERSON COUNTY					
Farm	1,573	1,543	1,263	1,145	-27.21
Ag. Serv., Forest, Fish.	--	248	588	633	155.24
Manufacturing	718	554	691	704	-1.95
Mining	<10	13	13	15	15.38
Construction	271	313	317	489	80.44
Transport. Com. & Util.	209	253	186	210	0.50
Wholesale Trade	565	538	361	378	-33.10
Retail Trade	534	593	596	778	45.69
Finance, Ins. & Real Est.	237	198	179	190	-19.83
Services	--	559	545	847	51.52
Federal Civilian	58	54	65	48	-17.24
Federal Military	101	84	112	106	4.95
State & Local Govern.	730	767	853	942	29.04
Total Employment	5,701	5,717	5,769	6,485	13.75
MADISON COUNTY					
Farm	1,044	1,052	822	740	-29.12
Ag. Serv., Forest, Fish.	131	154	265	--	102.29
Manufacturing	756	1,123	1,211	1,170	54.76
Mining	<10	<10	<10	--	--
Construction	585	377	320	390	-33.33
Transport. Com. & Util.	234	211	248	234	0
Wholesale Trade	687	832	717	784	14.12
Retail Trade	1,095	1,105	1,521	1,937	76.89
Finance, Ins. & Real Est	409	297	346	409	0
Services	2,479	3,063	3,056	3,485	40.58
Federal Civilian	53	47	48	56	5.66
Federal Military	129	115	159	154	19.37
State & Local Govern.	796	883	1,023	1,242	56.03
Total Employment	8,399	9,260	9,379	10,897	29.74

Source: Idaho Department of Commerce, 1994.

Table 6. Personal Income by Major Source and Earnings by Industry for Counties, 1994 (in thousands of dollars).

Item	COUNTIES Bonneville	Jefferson	Madison	State of Idaho	% of State Total
Income by place of residence					
Total personal income	1,499,763	251,552	263,213	20,703,335	9.73%
Nonfarm personal income	1,462,044	232,002	245,014	19,901,009	9.74%
Farm income	37,719	19,550	18,199	802,326	9.41%
Per capita personal income	18.9	13.6	11.1	18.3	--
Earnings by industry					
Agriculture services, forestry, fish & other	10,934	10,108	3,612*	221,950	11.11%
Mining	324	2,633	0*	217,683	1.36%
Construction	97,994	10,882	10,475	1,283,915	9.30%
Manufacturing	79,831	19,981	28,461	3,128,673	4.10%
Transportation & public utilities	37,364	6,004	9,034	865,584	6.05%
Wholesale trade	88,502	6,877	11,687	806,055	13.28%
Retail trade	128,573	9,075	27,131	1,662,953	9.91%
Finance, insurance, & real estate	34,287	2,021	4,559	855,452	4.78%
Services	426,992	7,432	71,137	3,123,179	16.19%
Government & gov. enterprises	149,395	22,107	29,151	2,498,986	8.03%
Population	79,200	18,400	23,700	1,133,100	10.71%

* **Note:** 1994 data for Agriculture and Mining categories for Madison County were not available. 3,612 and 0 are 1991 data.
Source: U. S. Department of Commerce, Bureau of Economic Analysis, 1996.

Table 7. Employment by Industry in the South Fork Snake River Basin and Surrounding Area (including Rigby).

Industry	Number Employed	% of the Total Employed
Agriculture, forestry, and fisheries	166	5.9
Mining	8	0.3
Construction	276	9.8
Manufacturing	275	9.8
Transportation	151	5.4
Communications & other public utilities	48	1.7
Wholesale trade	200	7.1
Retail trade	564	20.1
Finance, insurance & real estate	9	3.5
Business & repair services	102	3.6
Personal services	50	1.8
Entertainment & recreation services	24	0.9
Health services	89	3.2
Educational services	356	12.7
Other professional & related services	268	9.5
Public administration	136	4.8

Source: U.S. Census, 1990.

Although layoffs at the Idaho National Engineering and Environmental Laboratory have resulted in a reduction in service jobs, other sectors of the economy have continued to grow. Between 1988 and 1992, the service sector has generated the largest number of new jobs, almost 3,708 jobs in Bonneville, Jefferson and Madison counties (Table 5). Growth areas for all three counties include retail trade and state and local government. In the three counties, unemployment has remained below or near the state average since 1993 (Table 8).

The median family income in Bonneville, Jefferson and Madison counties is lower than the national median of $39,700 per year (Table 9). In Jefferson and Madison counties, median family incomes are lower than the state median of $32,900 per year. Between 1990 and 1995 personal income grew in all three counties at an annual average rate of 7.2 percent for Bonneville County, 6.8 percent for Jefferson and 9.8 percent for Madison (Table 10).

Table 8. Unemployment Rates for Bonneville, Jefferson and Madison Counties from 1991 - 1995.

	1991	1992	1993	1994	1995
Bonneville	4.5	5.0	4.7	4.4	5.0
Jefferson	6.4	6.8	5.8	5.6	5.9
Madison	5.2	4.5	4.4	4.1	4.3
Idaho	6.1	6.4	6.2	6.2	5.9

Source: Idaho Department of Employment 1994 and 1995a.

Table 9. 1995 Median Family Income in Bonneville, Jefferson and Madison Counties.

	Median Family Income
Bonneville	$39,600
Jefferson	$31,500
Madison	$30,800
Idaho	$32,900
United States	$39,700

Source: Idaho Department of Employment, 1995a.

Table 10. Personal Income for Bonneville, Jefferson and Madison Counties (current dollars).

Income	1980	1990	1992	1994	1995	% Annual Ave.
Bonneville County						
Personal income (millions)	587.2	1,191.0	1,369.0	1,577.7	1,686.0	7.2
Personal income per capita	8,850	16,400	17,700	19,400	20,300	4.4
Jefferson County						
Personal income (millions)	101.3	204.0	226.0	263.9	283.7	6.8
Personal income per capita	6,600	12,300	12,950	14,100	14,750	3.3
Madison County						
Personal income (millions)	125.2	230.0	245.0	341.4	367.5	9.8
Personal income per capita	6,350	9,700	10,250	13,200	13,800	7.3

Source: Idaho Power Company, 1994.

ENERGY SUPPLY AND CONSERVATION

Large quantities of electrical energy are produced within Idaho. Hydropower has traditionally been the principal source of electricity. Idahoans use more electricity per capita than the national average, which reflects the energy requirements of the agricultural industry and use of electrical energy for space heating. The electrical demand in Idaho continues to rise, and may be attributed to the growing population.

Electrical power service in the basin is provided by the Pacificorp-Utah Power and Light Division, and Lower Valley Power and Light and Fall River rural electric cooperatives. The Ririe, Heise and Lorenzo areas are served by Pacificorp and Fall River Electric. The Swan Valley and Conant Valley areas are served by Lower Valley Power and Light.

Pacificorp's electric generating facilities are located outside the basin, and include two hydroelectric projects on the Henrys Fork and six hydroelectric facilities elsewhere in southeast Idaho (Idaho Department of Water Resources [IDWR], 1995b). Although energy demands are increasing in the area, the corporation has existing capacity to meet future demands in the next five years (Barker, 1996). Fall River Electric also has seen an increase in energy demands in the basin (Jones, 1996). This cooperative purchases power from Bonneville Power Administration (BPA) and operates a hydroelectric facility at the Island Park Reservoir on the Henrys Fork. They also own the Felt project, located on the Upper Teton River, which is leased to Pacificorp.

Lower Valley Power and Light services the portion of the basin upstream of Heise with about 1000 residential accounts (Robinson, 1996). The cooperative primarily purchases power from the BPA, but also owns a 1.5 megawatt (MW) hydropower generating facility located in Wyoming on Strawberry Creek (U. S. Department of Interior, Bureau of Reclamation [USBR], 1996). Between 1979 and 1992, Lower Valley Power and Light had a 594 percent increase in electricity sales in Idaho (Idaho Department of Water Resources, 1994). Much of this increase is attributed to growth in the Teton Valley. Demands in the basin have increased about 2 percent a year since 1990, but are expected to increase at a greater rate in the near future (Robinson, 1996; Case, 1996). Within the next five years the cooperative plans to upgrade existing transmission lines to Teton Valley and along the Pine Creek drainage to address increased energy demands.

Currently liquefied gas is available in the Afton and Jackson areas as an alternative energy source. A pipeline is planned for construction into Swan Valley in the next five years (Case, 1996). This may shift some electric energy demands to natural gas.

Energy conservation is the more efficient use of energy by using less energy to produce a given service at a given amenity level. Conservation is widely regarded as a key method of meeting future energy demand. However, it is difficult to estimate how much energy will be gained through conservation measures, because it is dependent on the degree of implementation. Implementation depends largely upon the actions of individual homeowners, irrigators, and commercial entities, and therefore can vary widely.

Available conservation programs designed to increase energy use efficiencies play a major role in meeting part of the current and future increases in energy requirements. The Northwest Energy Code, locally-adopted building codes, and the Super Good Cents program support modern conservation standards for new residential and other construction. Other conservation advancements are also becoming increasingly feasible.

The Idaho Department of Water Resources' Energy Division provides information, technical assistance and financial support to promote cost-effective conservation, and utilization of energy efficient resources. One program works with manufactured home builders to construct energy-efficient homes. Since 1992, twenty-two manufactured homes have been built in the South

Fork Snake River Basin which exceed the U. S. Department of Housing and Urban Development and state energy standards. Energy-efficient homes built in the basin have resulted in a savings of about 117,300 kilowatt hours (kwh) annually, or $5,865 each year (at $.05 kwh). Compared to a site-built home constructed to the Idaho Residential Energy Standards, these same energy-efficient manufactured homes also represent a savings of 268,712 kwh per year, or $13,435 a year (Reece, 1996).

Existing facilities are eligible for energy conservation upgrading through several programs sponsored by state and federal agencies, and utility industries. These programs promote space and water heating conservation upgrades by providing low-interest loans to fund the installation costs of the measures. Existing public nonprofit schools and hospitals are eligible for energy conservation grants under the Institutional Conservation Program, funded by the U.S. Department of Energy and administered by the Energy Division of the Idaho Department of Water Resources.

While not part of any established conservation program, conversions to alternative sources of energy have been proposed to reduce dependence on over-committed sources. The increasing conversion from electrical space and water heating to natural gas is one example which is finding public favor. The proposed natural gas line into Swan Valley will provide this opportunity in the basin. Other alternative energy sources suggested include use of Idaho's geothermal, and renewable wood, solar, and wind resources. Geothermal energy is used in the form of hot water or steam produced within the earth for space heating in some local areas. Geothermal is used at Heise Hot Springs Resort to heat water in the pools. Use of wood for space heating has been popular in some areas, but potential problems with air pollution make it less attractive.

Water Resources

A standardized set of watershed boundaries were established for Idaho through a cooperative effort of several federal, state and private entities. These watershed boundaries allow consistency in referencing, data collection and reporting. These hydrologic units are indexed using the eight digit USGS Hydrologic Unit Code (HUC) and a two-digit extension. The South Fork Snake River Basin boundaries were delineated before watershed boundaries were finalized for the state. Consequently, the South Fork Snake Basin boundary does not perfectly match the watershed coverage established for the state. The Basin includes watersheds within hydrologic unit 17040104 and portions of watersheds within hydrologic unit 17040201. Future revision to the South Fork Snake River Basin Water Plan will include adjustment of basin boundaries to correspond to established watershed boundaries.

WATER QUANTITY

Surface Water

The South Fork Snake River basin comprises 1,000 square miles in eastern Idaho between the Idaho-Wyoming state line and the confluence with the Henrys Fork. Above Heise, the basin is mountainous and extensively forested; Palisades Reservoir and its tributaries delineate the upstream bounds. Below Heise, the South Fork Snake River traverses an alluvial fan opening on the Snake River Plain. Palisades, Rainey, Fall, and Pine creeks are the primary tributaries to the South Fork Snake River between Palisades Dam and the Henrys Fork confluence. The Snake River basin upstream of Palisades Dam drains an area of 5,208 square miles primarily in Wyoming.

USGS maintains four stream gaging stations within the basin by contract with State Water District 01 and USBR (Figure 4 and Table 11), and one reservoir gage at Palisades Reservoir. Forty-one additional gages measure diversions from the South Fork Snake River and Dry Bed. The historic data for these gages indicate that the average annual runoff at the Heise gage is approximately five million acre-feet (AF). Eighty-two percent of the Heise discharge is attributed to the Snake River drainage upstream of Palisades Reservoir in Wyoming. Annual reach gains from tributaries within the planning

Figure 4

Stream Gaging Stations

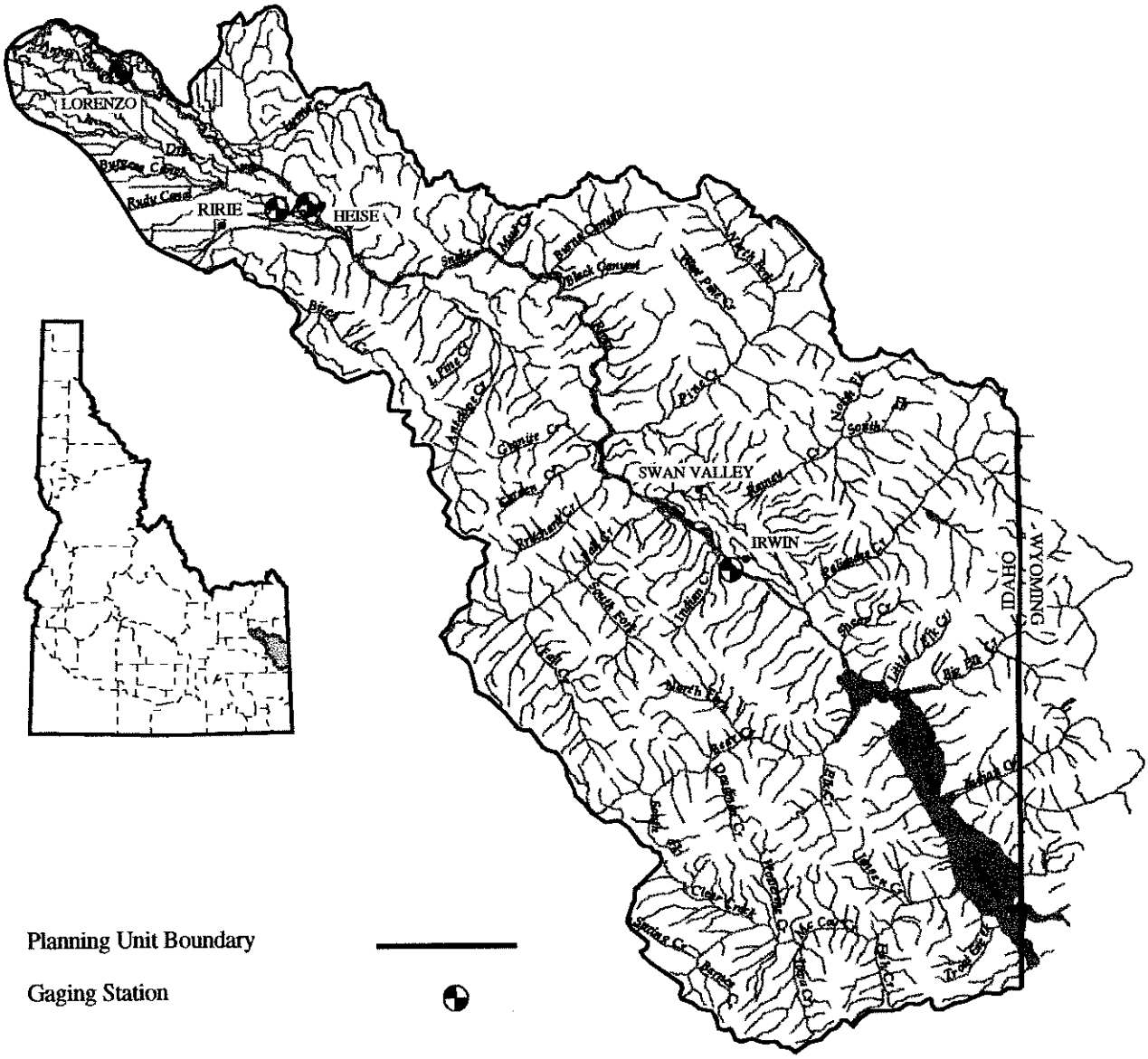


Table 11. Key Gaging Stations - South Fork Snake River.

Station	Gage	Period of Record	Drainage Area (sq. mi.)	Average Runoff Volume (ac-ft/yr)	Period of Record (acre-feet) Max.	Min.
#13032500 South Fork Snake River at Irwin	River	1949 to Present	5,225	4,814,200	6,707,500	2,621,900
#13037500 South Fork Snake River at Heise	River	1911 to Present	5,750	5,252,500	7,276,400	2,980,000
#13038500 South Fork Snake River at Lorenzo	River	1978 to Present	5,810	3,043,600	5,209,500	1,760,000
#130380 Dry Bed	Canal	1977 to Present	NA	1,169,500	1,287,200	1,069,300

basin average 400,000 AF to Palisades Reservoir, and 500,000 AF below Palisades Dam.

Although precipitation records for Swan Valley show that 56 percent of total annual precipitation falls during the growing season (April through September), the South Fork Snake River and its tributaries are fed largely by snowmelt (Molnau, 1993). About 50 percent of the basin runoff occurs in the May-July period. Snow water content at Lewis Lake Divide (elevation 7,860 feet), located in Yellowstone National Park Wyoming, averages 34.4 inches by May 1 (Ondrechen, 1996).

South Fork Snake River flows are regulated by releases at Jackson Lake (Wyoming) and Palisades Reservoir. During the summer irrigation period releases from these reservoirs are made to meet irrigation demand, flood control requirements and to balance stored water between the reservoirs. Factors influencing operation are described in the *Snake River Regulation* section of the Institutional Constraints and Opportunities chapter.

Winter releases from Palisades Dam are dictated by storage carried over the end of the irrigation season. In the driest years, releases in the late fall and winter have been less than 1,000 cubic feet per second (cfs). Flows at Heise are in the range of 1,300 to 1,500 cfs (Figure 5). When carry over allows, typical low flows are in the range of 2,500 to 3,000 cfs through the winter.

Floods of the South Fork Snake River and its tributaries result primarily from snowmelt and occur during late May, June, and early July in years when above normal snow packs have accumulated. Jackson Lake and Palisades Reservoir are operated as a system to control flows at Heise to 20,000 cfs or less during the spring snowmelt. The year of greatest runoff on record was 1986, when the computed natural discharge at Heise was over 7.6 million acre-feet, or 149 percent of normal. Precipitation and temperatures that occur during the flood runoff season, and Palisades Reservoir storage space determine the concentration of high flows and peak magnitudes.

The lowest natural runoff year of record was 1977. Runoff was 52 percent of normal at the Heise gage. The 1931-36 drought was the most severe in the basin's recorded history. Flows were 80 percent of the historical average over that period. The drought period of 1987-92 nearly eclipsed the earlier period for the low flow record (Idaho Department of Water Resources, 1996).

Flows on tributary streams are not regulated. The lowest flows occur in late summer, fall and winter seasons. Flows are usually at their highest during the spring snowmelt. Elevation of the creeks plays an important part in the timing of peak flows. Flows occasionally increase during the summer due to thunderstorms. Storm events may contribute unusually large proportions of the total flow of the South Fork Snake River for short periods of time.

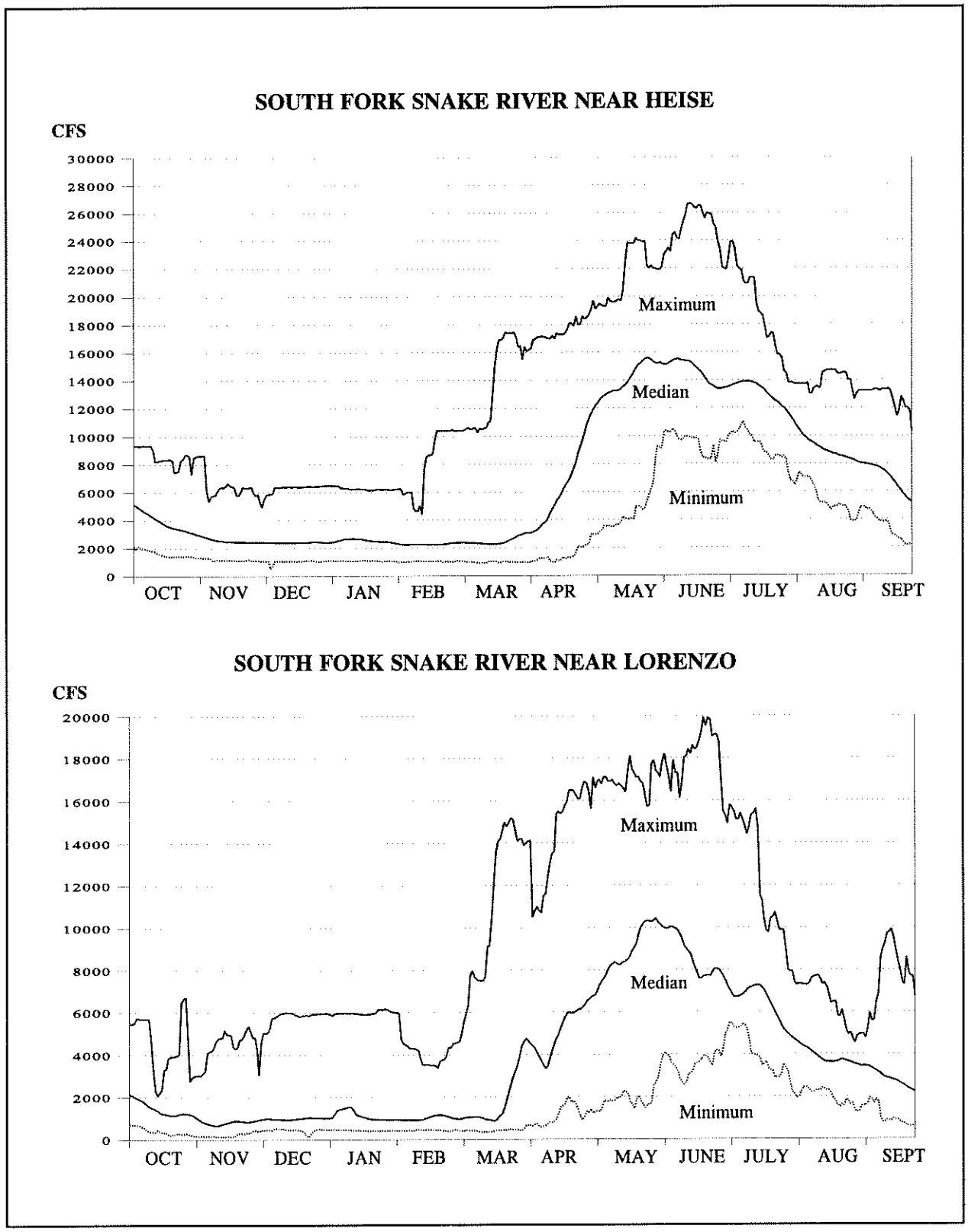


Figure 5. Averaged Daily Flows at Heise 1958-1992 and Lorenzo 1978-1992.

Ground Water

Alluvium along the South Fork Snake River and fractures in the basaltic and granitic rocks of the uplands and mountains provide ground water in the South Fork Snake River Basin. Alluvium in the upper valleys and on the Rigby Fan yield fairly large quantities of water to wells (Figure 6). Depth to ground water in the gravels is generally less than 70 feet with yields estimated at 500 to 2000 gallons per minute (1 to 4 cfs).

Alluvial aquifers are recharged by infiltration from the river and seepage from irrigated tracts. In the reach between Heise to Lorenzo, the South Fork Snake River loses approximately 250,000 AF per annum to ground water. Because of the porous nature of the soils in the basin most of the diverted water in the basin percolates into the alluvial materials of the Rigby Fan and then flows westward. Areas of the fan west of Ririe experience high water table problems as a result of the large amounts of recharge from irrigation. During the summer, ground-water levels rise as much as 30 feet and in some locations approach the land surface (Brockway and de Sonneville, 1973).

The water table occurs in the basaltic and silicic lava beneath the benchlands of the basin. The aquifers beneath the benchlands receive recharge from precipitation and by infiltration from the channels of streams that cross these benchlands. The geological formations in the area have sufficient porosity to accept fairly large volumes of water which reappear as stream flows during the late summer, fall, and winter. Recharge to ground water from precipitation on the northwest facing slopes of the highlands adjacent to the Snake River Plain is estimated to be on the order of 40,000 to 75,000 AF yearly (Mundorff, et al., 1960). With the exception of spring occurrences, depth to groundwater on the benchlands is generally a minimum of 100 feet, and can be tapped at 500 feet on the average with yields generally less than 50 gallons per minute. In the Swan Valley area, wells drawing water from stratum beneath the valley alluvium produce from 30-40 gallons per minute.

WATER ALLOCATION AND USE

The constitution and statutes of the State of Idaho declare all the waters of the state, when flowing in their natural channels, including ground waters, and the waters of all natural springs and lakes within the boundaries of the state, to be public waters. The constitution and statutes also guarantee the right to appropriate the public waters of the State of Idaho, and it is the state's duty to supervise that appropriation and allotment [Idaho Code 42-101]. Water rights are allocated by the state based on date of appropriation for specific quantities, diversion points, places of use, and purposes. Water rights are satisfied in order of priority based on date of appropriation. Changes in water rights such as diversion point or use require an application and approval by the IDWR. If a change exceeds 50 cfs or 5,000 AF, the change must be approved by the Idaho Legislature.

The natural flow of the Snake River above Milner Dam is fully appropriated, except in high water years. Most of the natural flow rights were decreed by the Rexburg Decree in 1910. Water supplies have been augmented by federally financed dams and reservoirs in the Upper Snake. The storage rights in Palisades Reservoir were established through the statutory state permit and licensing process. All of the canals below Heise have contracts for use of stored water from Jackson Lake, Palisades Reservoir, and by exchange, American Falls Reservoir.

The watermaster for Water District 01 administers the water rights above Milner Dam, including the South Fork Snake Basin, under supervision of the IDWR. On a daily basis the watermaster calculates the amount of natural flow available, total diversions, and the amount of stored water used by each space holder. Water accounting is accomplished using data from an automated system operated by USBR (known as the HYDROMET) which monitors important river gages and the majority of canal diversions. Data not available through the automated system is obtained through telephone. Each year over seven million AF of water for irrigation is distributed within Water District 01. The

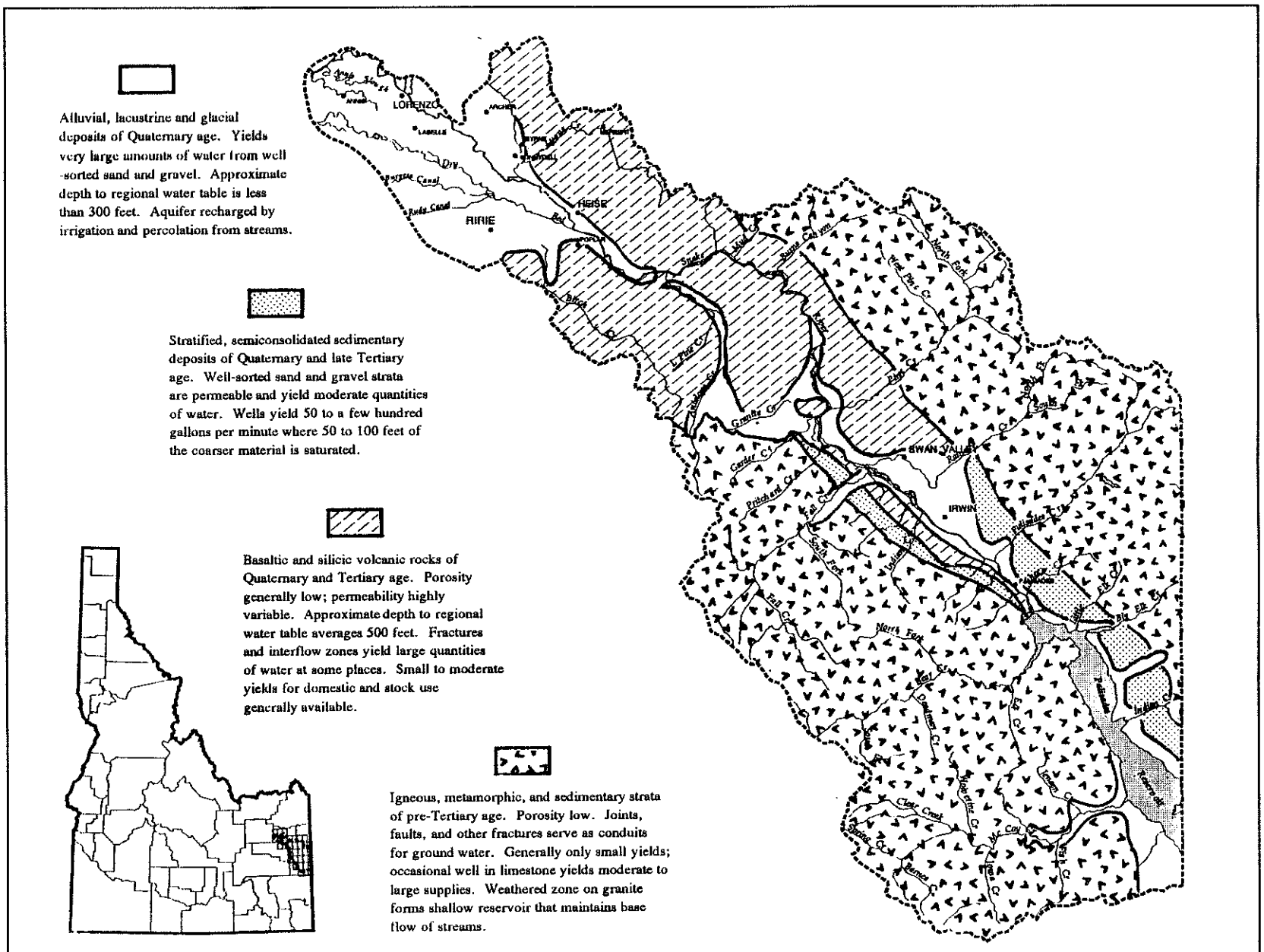


Figure 6. Aquifer Units (Pacific Northwest River Basins Commission, 1970).

watermaster also administers the District 01 Rental Pool (described on page 79) for the Committee of Nine.

The Committee of Nine consists of elected representatives of canal companies and irrigation districts in Water District 01. The Committee functions as a forum for discussion, consultation and advice on operation and administration of the Upper Snake Reservoir System. The Water District 01 watermaster and USBR Snake River Area Manager act as advisors to the Committee. The Committee proposes rules and rates for operation of the District 01 Water Rental Pool subject to Idaho Water Resource Board approval.

Figure 7 summarizes water use for the South Fork Snake Basin. Water appropriations in the basin total approximately two million AF annually (IDWR, 1996a). Water resources of the South Fork Snake Basin have been developed extensively for irrigation. However, other offstream and instream uses are significant and important to the area's economy. Hydroelectric power generation, fish, wildlife and the recreation/tourism industry are dependent on river flows. Power generation at Palisades Dam annually utilizes about 2 million AF of water that is released for irrigation and flood control purposes. Though small relative to other uses, domestic, commercial, industrial, and stock water use are essential to residents of the basin.

The Snake River is the source for the largest number and greatest volume of appropriations. Surface water supplies in the basin are primarily natural flow water rights and are the principal water source for irrigation. Storage provides, on average, only 15 percent of the water diverted above Lorenzo. Ground water comprises only three percent of the area's appropriated water, but it is relied on almost exclusively for domestic supplies. Thermal waters in the basin are scant. Heise Hot Springs is the only development using thermal water in the basin. Table 12 lists water use by stream reach.

Surface water appropriations in the basin are approximately 40 percent of the average annual discharge of the South Fork Snake River at Heise. From 1980 through 1990, irrigation diversions between Heise and Lorenzo ranged from 30 to 70 percent of the average South Fork Snake River flow at Heise during the irrigation season. Figure 8 shows the average monthly flow, recorded minimum monthly flow, and maximum diversion rate between Heise and Lorenzo. Minimum flows and maximum diversion rates are paired to illustrate potential water supply and river flow problems.

The high percolation losses through the canal systems may result in total diversion rates on the Rigby Fan of 10 AFA (acre feet per acre). About 70 percent of the water diverted for

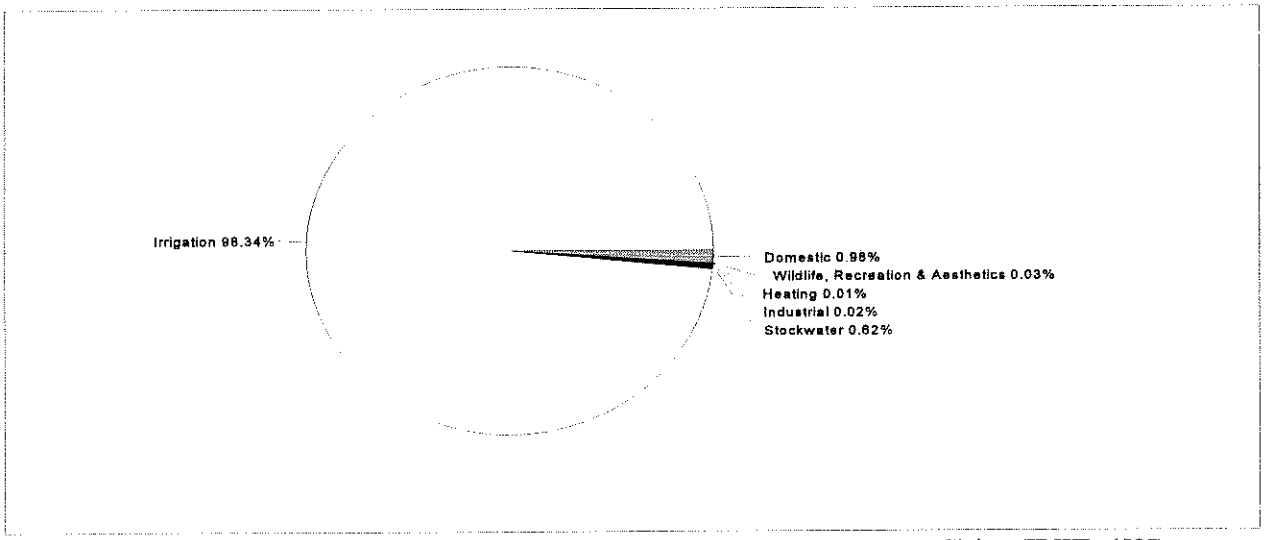


Figure 7. Water Use in the South Fork Snake Basin Based on Water Appropriations and Claims (IDWR, 1995).

Table 12. Water Use by Source for the South Fork Snake Basin.

Water Source	Number of Developments, Filings, or Claims	Total CFS of Diversions or Claims
Groundwater	2,120	450.00
Snake River	365	18,531.62
Springs	396	31.37
Antelope Creek	11	70.61
Big Elk Creek	3	5.04
Granite Creek	1	6.00
Indian Creek	9	13.14
Palisades Creek	37	252.19
Pritchard	5	8.19
Rainey Creek	44	80.96
Warm Springs	1	25.12
All Other Creeks: development < 5 cfs	289	102.72

Source: IDWR water right and adjudication database, 1995

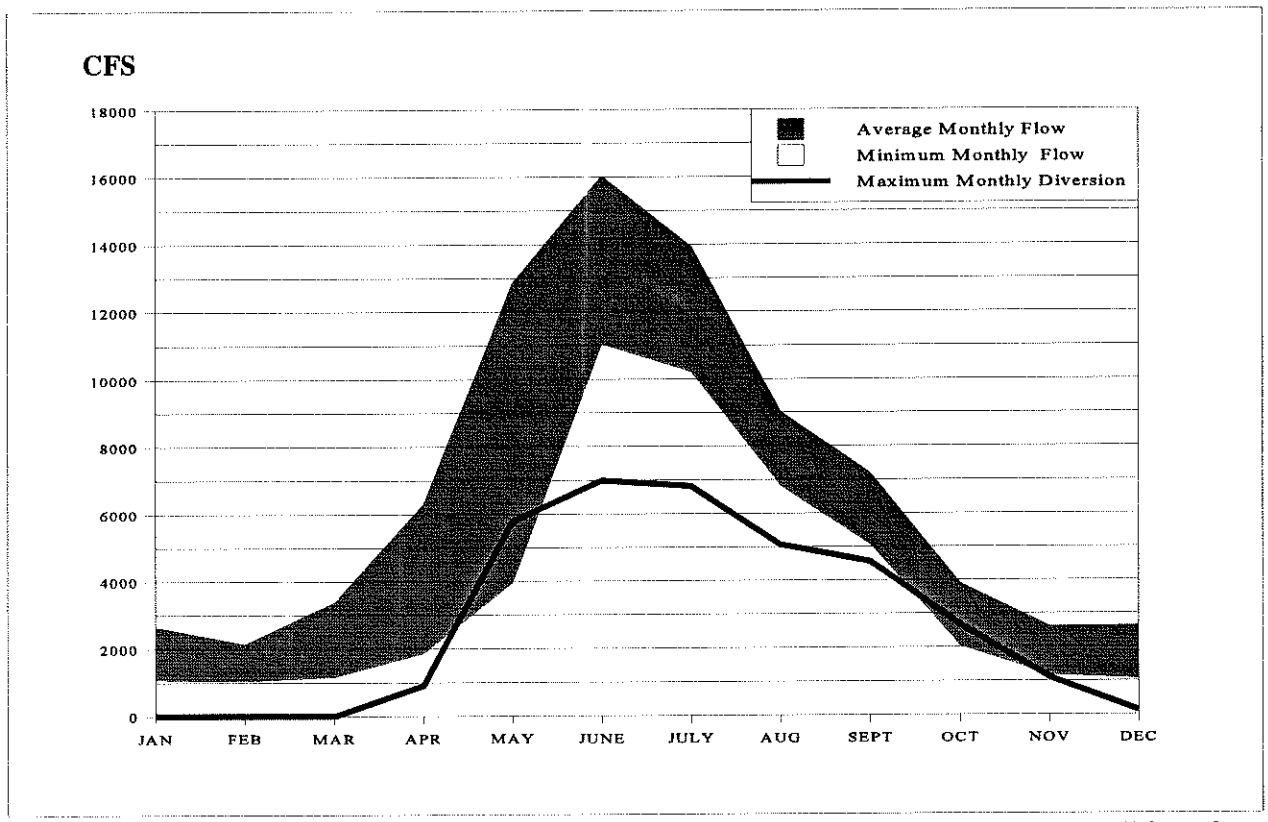


Figure 8. **South Fork Snake River Monthly Average Flows at Heise Gage and Diversions Between Heise and Lorenzo for 1980-1993.**

irrigation in the basin is not consumptively used. This was calculated assuming alfalfa planting (the highest water consumption rate at 3.5 AFA) for the 151,260 acres served by diversions between Heise and Lorenzo. Based on these assumptions, the calculated consumptive need for irrigation water in the basin approximates 529,410 AF (151,260 acres x 3.5 AFA). Canal distribution losses claim an estimated twenty-five percent of diverted irrigation water (SCS, 1977). On-farm distribution and irrigation application/seepage losses account for the remaining 45 percent.

Despite high application rates, total surface water diversions between Heise and Lorenzo have declined since the late 1970's. Currently, irrigators are diverting about 400,000 AF less from the basin than they did in 1974 (Figure 9). By comparison, the total annual diversions in Water District 01 have declined by over 800,000 AF since 1977. The change in diversion volume reflects improved water application efficiencies and administrative procedures implemented by Water District 01. Diversions from the South Fork between Heise and Lorenzo have decreased an average of 21,000 acre-feet per year over the last 19 years.

Agricultural Water Uses

Agriculture utilizes approximately 430,000 acres within the South Fork Snake River Basin. Upstream of Heise, about 55,000 acres of non-irrigated cropland covers the basin's uplands and benches, and livestock grazing is prevalent on forest and range lands. Beef and dairy cattle are dominant in the agriculture of the Swan Valley area. The bulk of irrigated land lies downstream of Heise on the Rigby Fan, where the river leaves the canyon and enters the Snake River Plain (Figure 10).

Thirty-four canals and 44 pumps annually divert and deliver about 1.7 million AF of water from the South Fork Snake River to irrigate farmsteads in the region (IDWR, 1995). Canals

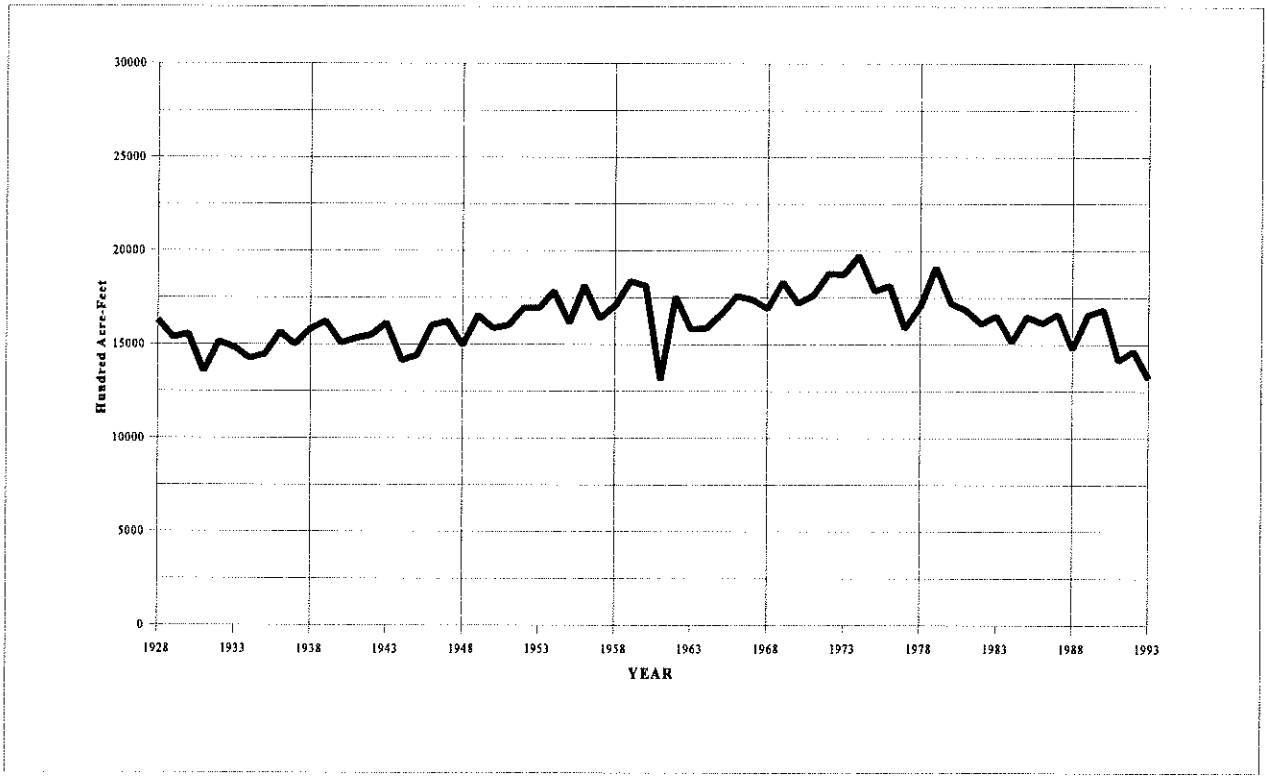
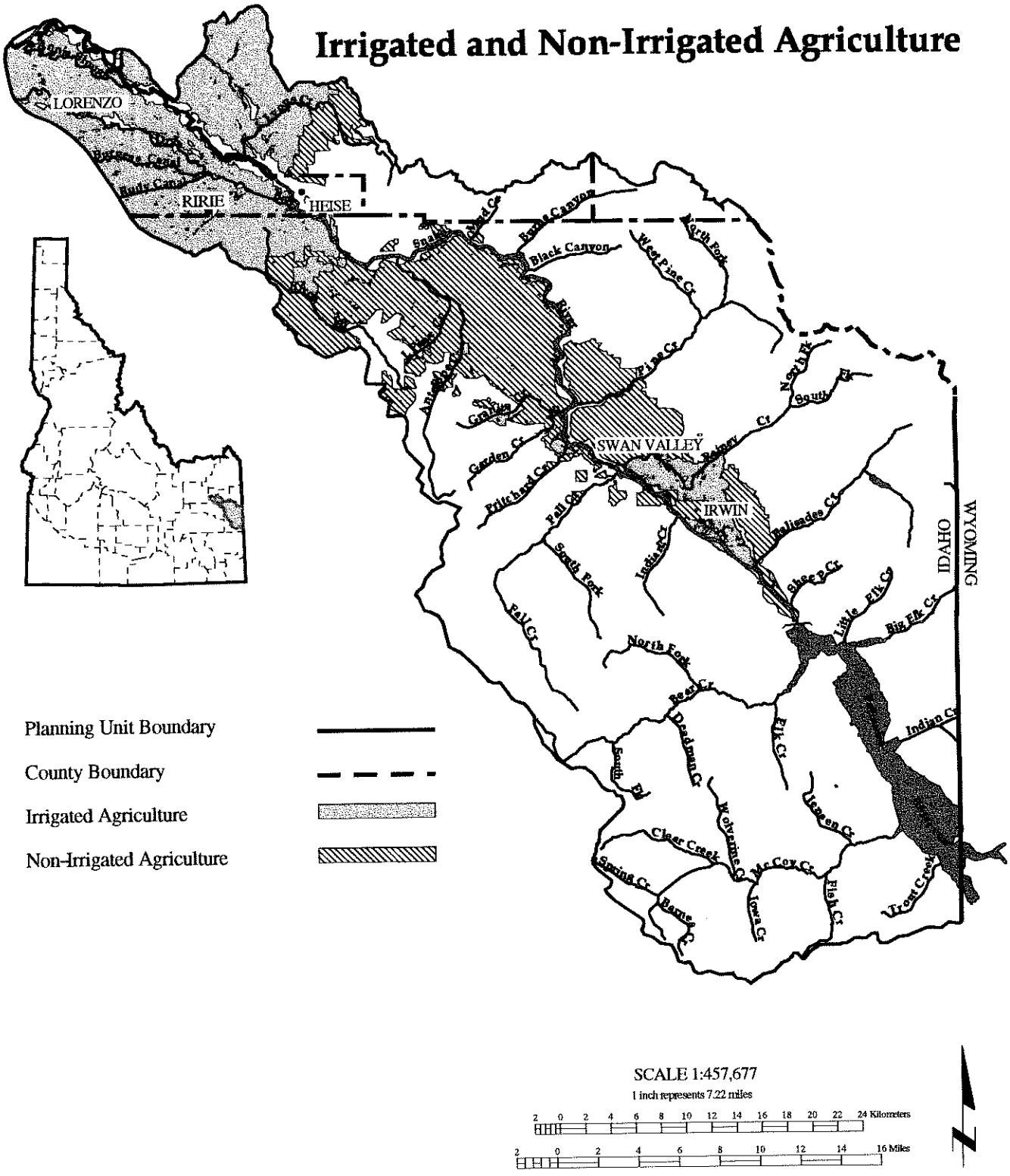


Figure 9. Sum of South Fork Snake River Irrigation Diversions Between Heise and Lorenzo 1928 to 1993.

Figure 10

Irrigated and Non-Irrigated Agriculture



divert an average of 1.5 million AF annually to irrigate the Rigby Fan; roughly 80 percent of this total is diverted via the Dry Bed. Right-bank gravity diversions average 230,000 AF. Pumping stations between Heise and Lorenzo divert approximately 3,500 AF annually. Several pumping stations of 500 horsepower or more lift water about 700 feet to uplands north of the river (Goodell, 1988). Watermaster reports show that water from storage comprises only 10-15 percent of total annual diversions between Heise and Lorenzo. About 75,000 AF of water are diverted for irrigation in the upper basin above Heise.

Sprinkler irrigation has steadily grown in the region with ground water development and drought precipitating water conservation measures. Today, approximately 40 percent of irrigated acreage in the South Fork Snake River Basin is watered by sprinklers compared with 17 percent in 1977. Figure 11 shows the distribution of sprinkler application in 1992.

The climate limits the crops that can be grown in the basin. The combination of soils and climate are suitable for potatoes, small grains, hay, pasture, feed corn and dry peas. In the high irrigated valleys, forage crops predominate and irrigated lands provide a winter feed base for livestock. Dryland crops constitute wheat and other small grains. Exotic grasses and wildflowers are grown on the Pine Bench.

Approximately two-thirds of the acreage irrigated by water diverted in the South Fork Snake Basin between Heise and Lorenzo is used to irrigate lands outside the basin in the Idaho Falls-Rexburg region. About 50,000 acres are irrigated within the basin with South Fork Snake diversions. Farmers irrigate an estimated 25,000 acres in the basin with ground water. Roughly 9,000 acres in the Antelope Flat and Swan Valley areas are irrigated from South Fork Snake River tributaries. Irrigation companies in the basin are listed in Table 13.

Irrigation with ground water began in the basin around the mid-1950's. Approximately 90,000 acre-feet of ground water is pumped annually for irrigation in the basin. Ground water is accessible with pumping lifts generally less than 70 feet. Most ground-water development has been conducted privately by individual farm operations, primarily in those areas not included in the initial surface water irrigation tracts because of their excessive elevation. Sprinkler irrigation is the most common irrigation method used with ground-water pumping. Within areas served by surface water diversion, individual farm operations have developed ground water as a supplemental water source and to increase the flexibility of on-farm irrigation methods and scheduling.

Beef cattle graze on public and private rangeland as well as irrigated pasture. Irrigated lands support much of the area's livestock industry. Animals grazed on nonirrigated public and private rangelands are wintered and fattened for market on feed grown on irrigated land. Most of the basin's sagebrush and forest range is public land administered by the BLM and the U.S. Forest Service. Active cattle and sheep grazing of these allotments account for an estimated 40,000 animal-unit months (AUMs) annually (Watson, 1993; Forest Service, 1993).

Livestock water use includes water for both stock watering and other on-farm needs. The quantity of water used by livestock in the South Fork Snake River Basin is estimated at 100 AF based on livestock numbers in the basin and average water use per head. On the range and in the mountains, livestock usually water freely at streams or springs unless a pump and watering station have been developed.

Domestic, Commercial, Municipal, and Industrial (DCMI) Water Uses

Domestic, commercial, municipal and industrial (DCMI) water use is small in the South Fork Snake River Basin, but essential to human life and economic development. Ground water supplies the domestic, commercial, municipal, and industrial needs in the basin.

Domestic and commercial water uses include drinking, food preparation, washing, and lawn

Figure 11

Irrigation Method (as of 1992)

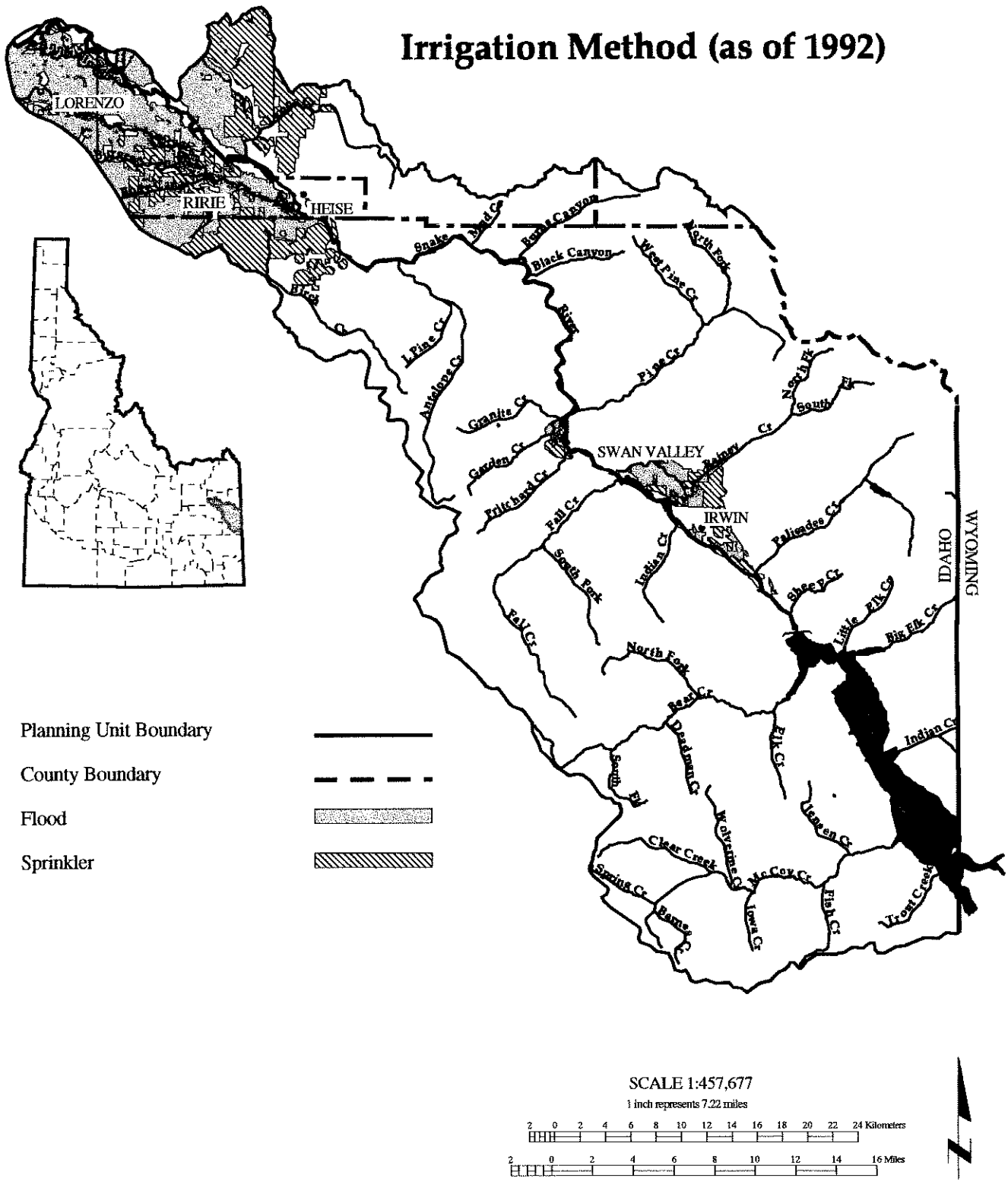


Table 13. Irrigated Cropland Acreages.

	Acres in Basin
Source	
Ground-water	25,500
Surface Water	
South Fork Snake River	43,590
South Fork Snake River Tributaries	8,465
Combined South Fork Snake River and Tributaries	300
Combined Ground Water and Surface Water Diversions	3,030
TOTAL	**80,885**
Irrigation Company or District	**Acres in Basin**
Bannock Feeder Canal Company	30
Burgess Canal and Irrigation Company	1,945
Butler Island Canal Company	1,830
Clark and Edwards Canal Company	2,260
Dilts Irrigation Company	670
Enterprise Canal Company	2,830
Farmers Friend Irrigation Company	2,000
Harrison Canal and Irrigation Company	70
Hill-Petinger Ditch	215
Island Irrigation Company	3,840
La Belle Irrigation Company	2,225
Combined West La Belle and Long Island Canal Company	6,550
Lenroot Canal Company	1,900
Liberty Park Irrigation Canal Company	100
Lowder Slough Canal Company	1,800
Nelson-Corey Ditch	450
North Rigby Irrigation and Canal Company	1,415
Parks & Lewisville Irrigation Company	700
Poplar Irrigation District	970
Progressive Irrigation District	520
The Reid Canal	180
Rigby Canal and Irrigation Company	1,000
Rudy Irrigation and Canal Company	3,100
Sunnydell Irrigation District	3,390
Private Birch Creek	815
Palisades Creek Water Users	2,615
Lower Rainey Creek	1,245
Upper Rainey Creek	2,190
Combined Organized Surface and Ground Water	1,930
Private Developments	
Ground Water	25,500
South Fork Snake River Diversions	3,600
South Fork Snake River Tributary Diversions	1,600
Combined South Fork Snake River and Tributary Diversions	300
Combined South Fork Snake River and Ground Water	1,100
TOTAL	**80,885**

Source: IDWR, 1978.

and garden watering. Residents of Irwin, Swan Valley, and Lorenzo obtain their domestic water from privately owned, relatively shallow, wells. In Irwin, water stands at about 32 feet below the ground surface, and the wells in general are in the neighborhood of 50 feet deep. Subsurface water in the Swan Valley area is about 8 feet below ground surface. Wells at varying depths tap this shallow subsurface water; some are drilled to greater depths for protection against contamination. Increased urbanization in this area represents a significant threat to ground water quality.

Community and municipal water systems provide approximately 30 percent of the water used for domestic and commercial purposes within the South Fork Snake River Basin. Community water systems service six subdivisions or developments in the Palisades area, and are managed by homeowner groups, the developer, or another private entity (DEQ, 1994). The only municipal water system in the basin is in the town of Ririe. The municipality supplies water to homes, commercial establishments, schools, the fire department, and a municipal park. The Ririe water system consists of three wells at depths of 120, 180, and 300 feet, and two elevated storage tanks that can hold over 120,000 gallons. The supply and distribution system for Ririe is considered adequate for current needs (Hall, 1996).

Industrial water use incorporates manufacturing processes, cooling, and employee sanitation. Food processing is the sole industrial use of water in the basin. The industry withdraws water for potato preparation and preservation. Water withdrawals for potato processing are highest from September through March. The largest water right for industrial use in the basin is 1.2 cfs from ground water.

At present, the total domestic, commercial, municipal, and industrial water use in the basin is an estimated 350 AF per year. Domestic use is calculated from population in the basin and average water use per day (Solley, 1993). Commercial, municipal, and industrial water demand is estimated from the water rights.

WATER DEVELOPMENT

Irrigation

The irrigated lands in the lower part of the basin are served by an extensive canal system that includes the Farmer's Friend, Burgess, Rudy, Harrison, Anderson, and Sunnydell canals. This system diverts water out of the South Fork Snake River through an extensive system of headworks and diversion dams. The Dry Bed, referred to as the "Great Feeder", was the main river channel before the South Fork Snake River moved to its present course in 1902. The Dry Bed is now operated as a feeder canal, utilizing head works to control the flow. In the Swan Valley-Irwin area, the Palisades Creek Canal diverts water out of Palisades Creek to irrigate lands near Irwin, while diversions are made out of Rainey Creek to irrigate lands along Rainey Creek and to the east of Swan Valley.

Enough reservoir storage space is available to augment natural flows and to supply the full requirements of lands diverting from the South Fork Snake River under most runoff conditions. A recurrence of extremely dry conditions such as occurred in 1987-92 would cause shortages throughout the basin. The reliability of water supplies on the smaller tributary streams contrast sharply with the reliability of supply on the South Fork Snake River because of lack of storage. For example, by late summer in years of below normal runoff the flow of Rainey Creek drops to less than one-half of the decreed amount. Lands receiving either all or part of their water supply from ground water are generally adequately supplied.

A preliminary investigation was conducted by the Natural Resource Conservation Service (formerly the Soil Conservation Service) at the request of the East Side Soil and Water Conservation District to determine if water efficiency could be improved on Rainey and Palisades creeks (SCS, 1994). Currently water is diverted from Rainey Creek by irrigators using individual delivery ditches. Losses in the present delivery system and water application methods limits the availability of full-season irrigation.

Some reaches of Rainey Creek are often de-watered during critical periods for fish passage. Most years the flow in Rainey Creek is not sufficient by late June to honor all irrigation water rights (SCS, 1994). The study also examined ways to improve delivery and on-farm application of irrigation water on land served by Palisades Creek.

The evaluated alternative entails constructing a gravity-pressurized pipeline to deliver 24.4 cfs from Rainey Creek for sprinkler irrigation. The proposal would result in essentially no delivery losses and could deliver enough water to consistently irrigate the 2000 acres with water rights instead of the 1600 acres that are now consistently irrigated. Increased efficiency would also provide water in the stream for fish migration. The preliminary cost for this project was estimated at $1,025,000 or $513 per irrigated acre (SCS, 1994). The preliminary study recommended further planning for this alternative, because the on-site and off-site benefits were significant.

The study also looked at improving the efficiency of Palisades Canal. Improvements to the Palisades Creek irrigation system, or a combination of improvements to Rainey and Palisades systems, were not considered feasible. The lack of adequate elevation within a reasonable distance made a gravity-pressurized irrigation system economically infeasible (SCS, 1994).

Practically all lands to which surface water can be applied have been developed for many years. Potentially irrigable land remains undeveloped because potential financial returns are not great enough to attract necessary capital, land is in federal ownership, and/or water available for new irrigation is limited. There are several thousand acres of good quality lands, currently dry farmed, on the benches above the South Fork Snake River between Heise and Swan Valley; 1,500 acres of potentially irrigable lands in the Swan Valley area are on the high uplands bordering the present irrigation development on the valley floor, and Antelope Flat has 12,700 acres. Most of this land lies at relatively high elevations, the growing season is comparatively short, and pump lifts to obtain water are high. For these reasons, only scattered areas of relatively small acreage are expected to be developed in the future.

Past studies have identified potential irrigation storage sites. Lynn Crandall/Burns Creek reservoir site has been studied in the past by the USBR as a storage reservoir. The site was reserved as a potential storage reservoir in the Idaho Water Resource Board's 1992 State Water Plan. The proposed location is near the mouth of Burns Creek at river mile 872.5 (Figure 12). Two configurations of the project have been examined. A 1961 proposal by the USBR would have a total capacity of 234,000 AF of water impounded by a 176-foot high dam. Approximately 9.5 miles of the river valley would have been inundated, providing 100,000 AF of supplemental irrigation water (USBR and Army Corp of Engineers [CoE], 1961).

A second development proposal in 1967 would provide irrigation storage replacement for Jackson Lake with a total capacity of 1.46 million AF. A 290-foot high dam would create a reservoir backing water near the existing Palisades Dam (USBR, 1967). In each proposal the reservoir served as a re-regulating reservoir for hydropower discharges at Palisades Dam, allowing an increase in the amount of power produced at the Palisades Powerplant.

Many other dam and reservoir sites in the basin have been studied by the USBR, CoE, USGS, and IDWR. A number of off-stream reservoir sites have been identified, although never seriously considered for development. Dam and reservoir sites studied are listed in Table 14.

Hydropower

Two hydropower generating facilities operate in the basin -- the Palisades Powerplant and Big Elk Creek (Figure 12). The Palisades Powerplant is a USBR facility located at the Palisades Dam.

Figure 12

Water Development

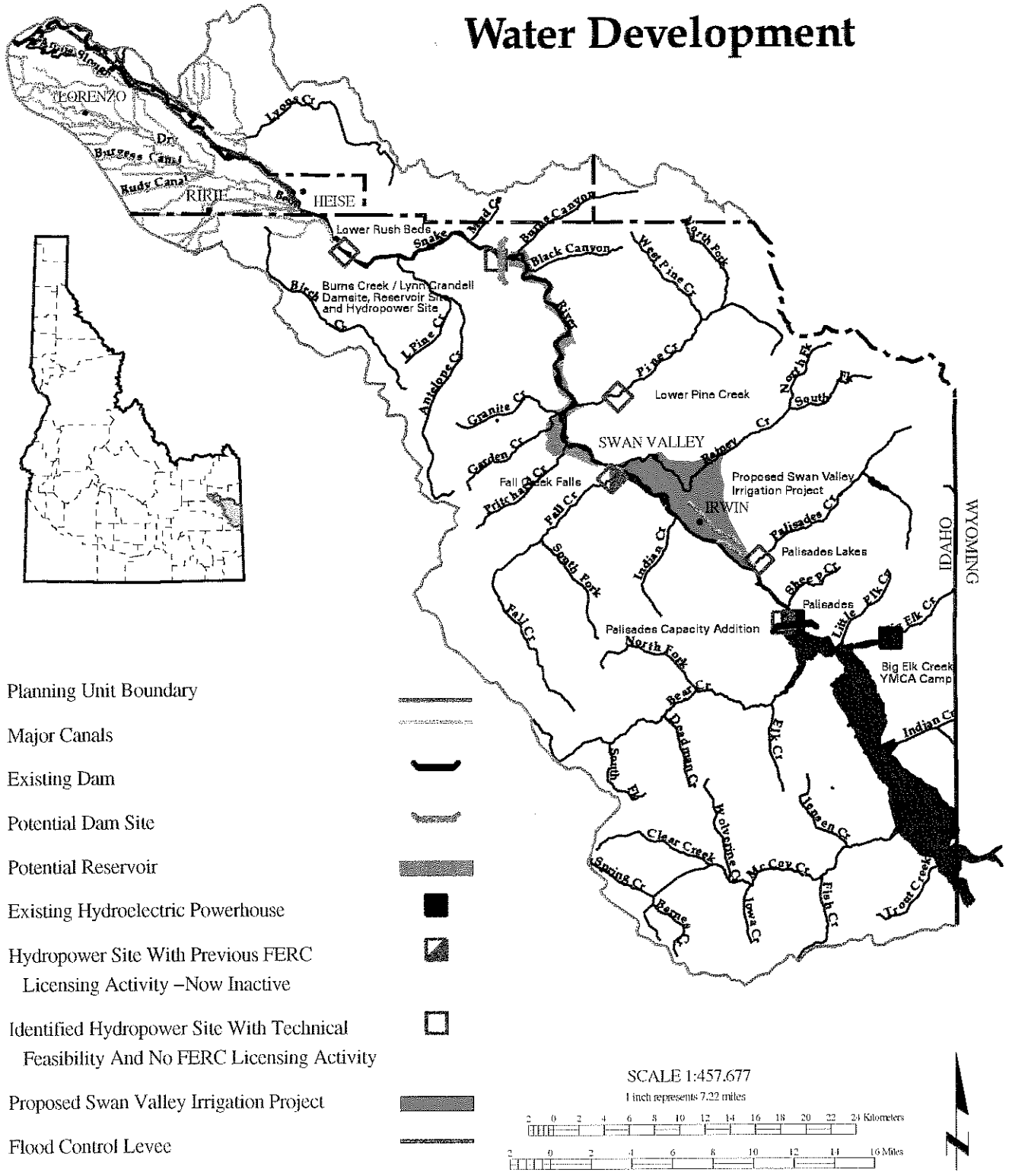


Table 14. Dam and Reservoir Sites Investigated in the South Fork Snake Basin.

Site	Location	Storage	Comment
Lynn Crandall/Burns Creek	South Fork Snake T3N, R42E, Sec. 14	234,000 AF 1,460,000 AF	Two alternatives studied
Rainey Creek Dam & Reservoir	Rainey Creek T1N, R44E, Sec. 33	8,000 A-F	High cost per irrigated acre
Swan Valley Dam & Reservoir	South Fork Snake T1N, R44E, Sec. 33	500,000 A-F	Dam site would be inundated by Lynn Crandall. Geology questionable.
Conant Valley Dam & Reservoir	South Fork Snake T2N, R43E, Sec. 20	750,000 A-F	Dam site would be inundated by Lynn Crandall. Geology questionable.
Dry Creek Dam & Reservoir	South Fork Snake T3N, R43E, Sec. 30	950,000 A-F	Dam site would be inundated by Lynn Crandall. Geology questionable.
Black Canyon Dam & Reservoir	South Fork Snake T3N, R42E, Sec. 13	1,200,000 A-F	Dam site would be inundated by Lynn Crandall. Geology questionable.
Wolverine Creek Dam & Reservoir	South Fork Snake T3N, R42E, Sec. 5	1,500,000 A-F	Lynn Crandall preferred.
Table Rock Dam & Reservoir	South Fork Snake T3N, R41E, Sec. 12	1,500,000 A-F	Lynn Crandall preferred.
Clark Ranch	South Fork Snake T3N, R41E, Sec. 15	1,500,000 A-F	Lynn Crandall preferred.
Birch Creek Dam & Reservoir	Birch Creek T3N, R40E, Sec. 23	6,000 A-F	High cost per irrigated acre.
Offstream Sites			
Gibson Creek-Fall Creek	T1N, R42E, Sec. 34	262,000 A-F	
Swan Valley-Indian Creek	T1N, R44E, Sec. 30	32,000 A-F	
Indian Creek #2	T1N, R43E, Sec. 29	35,000 A-F	
Fall Creek	T1N, R43E, Sec. 8	58,000 A-F	
Fall Creek #2	T1N, R43E, Sec. 8	68,000 A-F	
Fall Creek Falls	T1N, R43E, Sec. 3	94,000 A-F	
Birch Creek	T3N, R43E, Sec. 33	45,000 A-F	
Rainey Creek	T2N, R44E, Sec. 33	250,000 A-F	
Palisades Creek	T1N, R44E, Sec. 35	41,000 A-F	

Sources: USBR and CoE, 1961; USGS, 1965; Idaho Water Resource Board, 1968; CoE, 1995; and Idaho Water Resource Research Institute, 1979.

This facility began power production in 1957. The four original generators each had a nameplate capacity of 28.5 megawatts (MW), for a total installed capacity of 114 MW. During the period of 1992 to 1994, the powerplant capacity was upgraded as part of the USBR's ongoing program of increasing the capacity at existing powerplants. The powerplant now consists of four generators, each with a nameplate capacity of 44.1 MW, for a total installed capacity of 176.6 MW.

The Big Elk Creek Powerplant was licensed as Federal Energy Regulatory Commission (FERC) license #6636. The facility, located on Big Elk Creek, has an installed capacity of 7.5 kw. The power produced by this facility is not marketed commercially, but is used at the Idaho Falls Family YMCA Camp located at Big Elk Creek. This facility was granted a FERC exemption in 1982, and has been operational since 1987 (IDWR, 1995b).

Several hydropower development opportunities have been identified in the basin by past studies. These are summarized in Table 15 and shown in Figure 12. None of the sites appear to be economically feasible under current electric rate schedules. The FERC oversees the licensing of privately operated projects. Three hydroprojects pursued FERC licensing in the past, but are currently inactive.

Flood Management

Flood control is one of the authorized benefits of the Palisades Project, and the USBR is required to follow the established flood control curves for the project. Jackson Lake and Palisade Reservoir provide major flood control in the South Fork Snake Basin. Jackson Lake provides incidental reduction of flood peaks averaging 5,500 cfs, reducing flows by 0 to 8,500 cfs (Wirkus, 1996). Palisades Reservoir provides reduction of flood peaks averaging about 16,800 cfs, reducing flows from 0 to 30,000 cfs. The estimated discharge on the South Fork Snake River at Heise for a 100-year flood event without considering existing flood control dams is 58,300 cfs (Federal Emergency Management Agency, 1981). The estimated flow with the existing flood control dams is 30,000 cfs.

Reservoir releases for flood management are dependent on the amount of storage that must be evacuated with respect to runoff forecasts. Under a plan formulated by the USBR, CoE, and other interested groups, all but the larger floods are regulated to about 20,000 cfs or less near Heise. The extreme flood will be reduced to the maximum practical extent (CoE, 1988). Since the completion of Palisades Dam in 1957, flood peaks in excess of 25,000 cfs at the Heise gage have occurred on four occasions, with a maximum flow of 27,000 cfs on June 18, 1986. Regulation of the South Fork Snake River with the dams in place is illustrated in Table 16.

Below Palisades Dam the safe channel capacity of the South Fork Snake River varies from 15,000 cfs to 35,000 cfs (CoE, 1988). At river flows between 15,000 and 20,000 cfs, small areas along the river, usually covered with pasture grass and annually subject to main river

Table 15. Hydropower Sites Identified in South Fork Snake River Basin.

Site	Potential Capacity	Location
Burns Creek / Lynn Crandall	320,628 kw	South Fork Snake River at Burns Canyon
Palisades Dam	90,000 kw	South Fork Snake River at existing Palisades Dam
Palisades Capacity Addition	90,000 kw	South Fork Snake River at existing Palisades Dam
Fall Creek Falls	468 kw	Fall Creek above the Falls
Palisade Lakes	6948 kw	Palisades Creek
Lower Pine Creek	2730 kw	Pine Creek
Lower Rush Beds	39,000 kw	South Fork Snake River above the Riley Ditch

Sources: USBR and CoE, 1961; USBR, 1967; IWRB, 1968; CoE, 1981; and CoE, 1995.

Table 16. Flood Control Regulation on the South Fork Snake River.

Date	Natural Discharge *(if uncontrolled by upstream projects)*	Regulated Discharge
June 7, 1963	28,000 cfs	25,400 cfs
June 30, 1970	33,800 cfs	25,500 cfs
June 26, 1974	48,100 cfs	26,200 cfs
June 18, 1986	56,900 cfs	27,000 cfs
July 14, 1995	34,300 cfs	22,400 cfs
June 18, 1996	48,300 cfs	24,100 cfs

Source: USBR HYDROMET database.

overflow, are inundated. Bank cutting may be appreciable in some locations at these flows. Channel capacity of the South Fork Snake River at Swan Valley is about 25,000 cfs.

Downstream from Heise, stream bed materials, low banks and gradient induce river meanders. The normal river channel capacity in the Heise to Henrys Fork reach is approximately 20,000 cfs. Between the Great Feeder intake near Heise and the Henrys Fork, an offset levee system was constructed in the early 1960's by the CoE to pass floods up to a magnitude of 30,000 cfs, enough to accommodate the regulated 100-year flood. However, major channel shifts could unpredictably impinge the levees in this reach. Sustained high velocity flows may erode levees and increase flooding risks.

A flood control district, established pursuant to Idaho Code, was organized on the South Fork Snake River in Jefferson and Madison counties in 1946. Flood Control District No.1 maintains the levee system between Heise and Roberts, Idaho. District No. 1 goals are (1) to discourage development in the floodplain, (2) seek to protect and maintain present flood works, and (3) contain flood flows within the present river channel. To this end the District's objectives include identifying and publicizing flood prone areas, assisting in the adoption of a Flood Plain Management Plan, and supporting additional upstream storage projects. The District retains a person for weekly inspection of flood works during spring flows, and has also acquired quarry sites to provide riprap material for flood dike maintenance (Kremer, 1993).

Bonneville, Jefferson, and Madison counties, and the communities of Swan Valley and Irwin participate in the National Flood Insurance Program (NFIP). The program was established in 1968 by the National Flood Insurance Act making flood insurance, previously unavailable from private insurers, available through a federally subsidized program. To participate, communities or counties must adopt a floodplain ordinance specifying land use measures in flood prone areas to avoid or reduce future flood damage. The Federal Emergency Management Agency (FEMA) that administers the NFIP program has established minimum standards for participating agencies.

Floodplain ordinance requirements include elevating the lowest floor of a structure constructed in the 100-year floodplain at or above the base elevation of the 100-year flood. (The 100-year floodplain includes lands subject to a 1 percent or greater chance of flooding in any given year.) Sanitary systems and water supply systems located in the 100-year floodplain must be designed to minimize or eliminate infiltration of flood waters. Development must not encroach into the floodway and must not increase flood levels. (The floodway is an area immediately adjacent to a river or stream channel which becomes the enlarged stream or river channel during flooding.) The participating county or community is responsible for enforcing flood plain ordinance requirements, and determining that other required federal, state and local permits have been obtained before issuing a development permit.

Participation in the NFIP makes flood insurance available to property owners. Any mortgage, loan, grant, or other funding provided, insured or regulated by a Federal agency for a structure located in the floodplain must purchase flood insurance by law. Many lenders may also require flood insurance for conventional loans.

FEMA conducts studies and prepares maps depicting flood hazard information. These maps identify boundaries of the 100-year floodplain and the floodways. Floodplain mapping was completed in 1981 for Bonneville County, 1988 for Jefferson County, 1991 for Madison County, and 1980 for Swan Valley.

WATER QUALITY

The South Fork Snake River from the Wyoming state line to Heise (segment USB-10) and from Heise to Roberts (below the confluence with Henrys Fork; segment USB-20) are designated by the Division of Environmental Quality (DEQ) as Special Resource Waters (Figure 13). Special Resource Waters are specific segments or bodies of water recognized as needing intensive protection to preserve outstanding or unique characteristics, or maintain current beneficial uses. The South Fork Snake River is currently designated by DEQ for the following beneficial uses: domestic water supply, agriculture water supply, coldwater biota, salmonid spawning, and primary and secondary contact recreation (Drewes, 1991). The *Idaho Water Quality Status Report Nonpoint Assessment* rates water quality for the South Fork Snake River as good overall (Idaho Department of Health and Welfare, DEQ, 1992; Drewes, 1991).

In 1994, the Environmental Protection Agency (EPA), under authority of the Federal Clean Water Act, released a 303d list which identified 962 water quality limited waterways in Idaho. A water quality limited segment is a reach which does not fully support all designated beneficial uses. A beneficial use is defined as, "The reasonable and appropriate use of water for a purpose consistent with Idaho state laws and the best interest of the people" (DEQ, 1992). The South Fork Snake River from Palisades Dam to Heise is listed as a water quality limited segment because of flow alteration (EPA, 1996; Figure 13). Listed tributaries in the basin include Antelope and McCoy creeks. Antelope Creek was listed for sediment problems. No specific pollutant is identified for McCoy Creek in the 303d list. All of these reaches are listed as low priority, indicating that designated uses are not fully supported, but risks to human health, aquatic life, recreation, economic, or aesthetics of the water body are minimal.

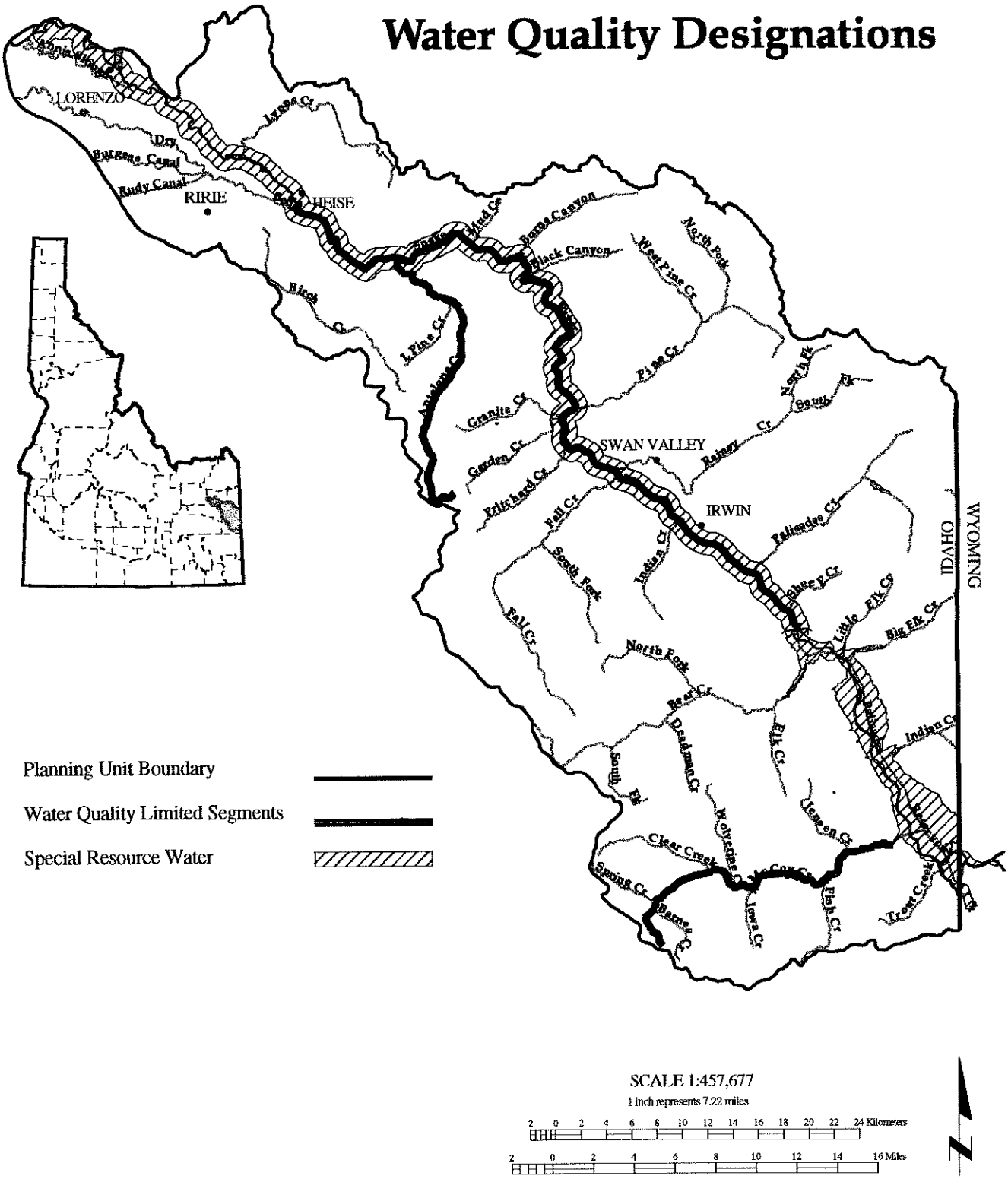
A water quality limited designation by EPA requires development of total maximum daily load (TMDL) standards. A total maximum daily load is the sum of all source and nonsource contributions for a pollutant in a waterway. Pollutant levels established through the TMDL process must be at or below the level established for the waterway to abide by water quality standards. TMDLs were developed as a tool for allocating acceptable contaminant loads from different sources to meet state water quality standards.

The Idaho Legislature passed legislation in 1995 (S.B. 1284) which requires establishment of community-based citizen advisory groups to make recommendations to DEQ and other resource agencies about proper management of impaired waters to comply with state water quality standards. This legislation required DEQ to establish Basin Advisory Groups (BAGs) and Watershed Advisory Groups (WAGs) for each major basin and their watersheds, to make recommendations concerning monitoring, standards revisions, prioritization, and the development of TMDLs and pollution control strategies.

On September 26, 1996, the U. S. District Court for the Western Division of Washington ordered EPA to submit a schedule for completing TMDLs, or their functional equivalent, for all Idaho waters on the 303d list by March 26, 1996. All waters, including those with low priority, are to have TMDLs developed within five years. EPA is legally required to approve Idaho's TMDL plans and to approve a TMDL. EPA requires that a TMDL include reasonable

Figure 13

Water Quality Designations



assurances or monitoring to show that nonpoint source improvements are actually achieved.

The state is required to use the TMDL process to protect beneficial uses of the South Fork Snake River. Flow alteration is listed as a pollutant for the South Fork Snake, because altered flow conditions could threaten or prevent full attainment of beneficial uses such as salmonid spawning and cold water biota (EPA, 1994). End-of-pipe point source pollution (such as treated municipal sewage) is not currently a significant source of pollution for the South Fork Snake River. State water quality standards do not specifically address flow. Since EPA considers flow alteration a form of nonpoint source pollution, the appropriate remedy may be in the form of flow management through the operation of Palisades Dam. However, flow regimes on the South Fork Snake River are controlled by contractual reservoir storage rights and water rights to divert for agricultural and other uses. Flow management must occur in accordance with Idaho law and other constraints.

Water quality data collected by the U.S. Geological Survey (USGS) is available for several stations on the South Fork Snake River. Data availability, time frames and parameters measured vary at each gage. USGS water quality analyses conducted at Heise from 1911 to 1994, and at Lorenzo from 1924 to 1994, for several selected constituents are summarized in Table 17.

Suspended Solids

Suspended solids are good indicators of nonpoint source agricultural pollution (Drewes, 1991). Soil particles are typically entrained in the water column from about three inches above the bottom to the top of the column. Suspended sediment concentrations in the South Fork Snake Basin are influenced by three factors: channel washing, direct input, and dilution (Drewes, 1991). (Channel washing is the flushing of soil and debris that builds up during low flows. Direct input is material washed directly into streams from surrounding lands. Dilution is the result of input of relatively "cleaner" waters into the system.)

The DEQ prepared a State Agricultural Water Quality Plan (SAWQP) for the Antelope-Pine creeks area. The study collected samples for a period from October 1987 to May 1989 from Palisades Dam to Heise, and on several tributaries of the main stem -- Antelope, East Birch, Granite, Pine and Rainey creeks (Drewes, 1991).

The SAWQP determined agricultural impacts on the South Fork Snake River were minimal (Drewes, 1991). Suspended solid measurements below Palisades Dam never exceeded the EPA Water Quality Index guidelines for no impact during the 1987-1989 SAWQP study. At the Heise gage sediment loads exceeded EPA guidelines for a moderately polluted river twice (Drewes, 1991).

Intermittent streams contribute the highest concentrations of suspended sediments into the South Fork Snake River. This is the result of three characteristics: 1) close proximity to farmland; 2) lack of water and exposure of stream bottoms leading to greater washing during spring runoff; and 3) lack of a bedrock stream bottom allowing greater contact with soils and mass wasting (Drewes, 1991). By comparison perennial streams tend to have well-developed riparian areas, stream beds and banks, preventing erosion of upland soils during high flows and filtering pollutants from adjacent farmlands. The greatest contributor of suspended solids (also inorganic nitrogen and phosphorus) to the main stem are East Birch, Antelope, and Granite creeks (Drewes, 1991).

Sources of sediment, in addition to agricultural practices (farming and grazing), include wildlife grazing, recreation, residential development, mining, timber harvest, road and trail construction, and forest and range fires (BLM and Forest Service, 1991). Roads, specifically those within riparian areas, generally contribute 85-90 percent of sediment reaching streams in disturbed forest land (Targhee National Forest, 1996a). Another source of sediment is stream bank erosion due to compaction, stream bank trampling, and channel movement.

Table 17. Water Quality Constituent Statistics for Two Sample Locations on the South Fork Snake River.

		Temp. (deg. C)	Flow * (cfs)	pH (Std)	Dissolved Oxygen (mg/l)	Fecal Coliform (colonies/ 100 ml)	Dissolved Solids (tons/ day)	Nutrients (mg/l)			
								Nitrogen Total (as N)	Nitrogen Nitrite + Nitrate (dissolved as N)	Ortho-phosphate (dissolved as P)	Phosphorus Total (as P)
Station: **Heise** (13037500)	Sample Size or Period of Record	270	1911 - 1994	632	130	94	575	75	151	49	161
	Mean	7.25	6930	7.9	10.4	20.4	4020	.68	.31	.05	.04
	Range	0 -23.0	460 - 51,600	6.5 - 8.8	7.8 - 13.6	1 - 150	868 - 17,700	.05 - 4.70	<0.1 - 6.4	.01 - .98	<.01 - .40
Station: **Lorenzo** (13038500)	Sample Size or Period of Record	112	1924 - 1994	9	9	9			6	9	9
	Mean	8.29	4050	8.5	10.6	15.4			0.1	.01	.03
	Range	0 - 17.5	110 - 19,900	8.1 - 8.7	9 - 12.7	1 - 63			0.1 - 0.2	<.01 - .01	.01 - .05

* Flow (cfs) = mean annual; high and low mean daily values given for range

Source: USGS, 1996; and Milligan et al., 1983.

Agricultural practices resulting in sedimentation in streams are expected to be reduced through cost sharing programs organized under the auspices of the Soil and Water Conservation District. Best management practices (BMPs) are proposed on 47,000 cultivated acres located on tributaries to the South Fork Snake River. The goal is to reduce erosion to 5 tons/acre/year. Projects are occurring on Antelope and Pine Creek drainages (BLM and Forest Service, 1991).

Nutrients

Nutrients typically include compounds of nitrogen and phosphorus. Those monitored in the SAWQP study included total Kjeldahl nitrogen, nitrate, nitrite and ammonia nitrogen, ortho-phosphate phosphorus, and total phosphorus (Drewes, 1991). Organic nitrogen was calculated by subtracting the ammonia value from the Kjeldahl nitrogen value. The recommended inorganic limit for total nitrogen to prevent development of aquatic nuisance vegetation is 0.3 milligram/liter (mg/l) (Mackenthun, 1973). Total nitrogen levels exceeded the recommended levels in 11 of 77 samples taken at Heise in the SAWQP study (Drewes, 1991). Inorganic nitrogen levels exceeded recommended levels on the tributaries to the following extent: East Birch Creek (18 of 18), Antelope (4 of 18), Granite (4 of 18), Pine (1 of 18), and Rainey (0 of 18). Nitrogen sources appeared to be from agricultural practices, particularly in areas where tributaries flowed through pastures (Drewes, 1991).

Phosphorus can be tightly bound with soil particles. Consequently, phosphorus is normally transported with sediment and may increase with suspended solid concentrations. Phosphorus occurs naturally throughout the basin. High enough levels occur in basin soils that it is rarely applied in agricultural practice.

The results from the SAWQP study indicate that total phosphorus levels in the intermittent streams exceeded the 0.1 mg/l recommended limit in 67 percent of the samples (Drewes, 1991). The established, perennial streams exceeded the recommended limit 23 percent of the time. The dissolved ortho-phosphate phosphorus level exceeded the 0.025 mg/l recommended limit in 18 percent of the intermittent stream samples and in 5 percent of the perennial tributary samples. Phosphorus concentrations were not detectable below Palisades Dam. It is assumed that phosphorus upstream settles out with sediments in the reservoir (Drewes, 1991). Farming practices are the principle man-caused source of total phosphorus below Palisades Dam. It was not known whether the majority of ortho-phosphate phosphorus came from agricultural or residential sources or both, but occurrence followed the same pattern as the total phosphorus (Drewes, 1991).

Bacteria

Bacteria standards for the South Fork Snake River are determined by the designated uses established (DEQ, 1992). The main stem is protected for primary contact recreation, which is the most limiting standard. No records for bacteria at Heise exceeded the recommended standard of 500 colonies/100 ml (Drewes, 1991). In 198,1 fecal coliform counts were significantly higher at the Menan gage (outside the basin and below the confluence with the Henrys Fork) than at Heise (USGS STORET data). Rainey and Granite creeks exceeded the recommended bacteria levels at least once (Drewes, 1991). Both Rainey and Granite creeks run through livestock pastures, and fecal coliform-streptococcus ratios indicate that livestock are the main contributor (Drewes, 1991). Samples for Rainey Creek showed human fecal coliform contamination as well.

Other Water Quality Parameters

Additional water quality parameters measured included temperature, dissolved oxygen, and pH. At Heise, the temperature requirements for salmonid spawning (13° C or less) were met during the spawning season. The temperature reached 14-15° C in July and September (Table 17). The minimum standard for dissolved oxygen for salmonid spawning (6 mg/l) has been met at Heise since 1911 (lowest is 7.8 mg/l).

The pH range of 6.5 - 9.5, established for surface water aquatic life, was not exceeded at Heise. The pH level has remained relatively steady within the range established for surface water standards.

A preliminary study done by DEQ in 1994 during an unusually low volume in Palisades Reservoir, indicated that river water temperatures (taken 750 meters below dam) did exceed the overall maximum (13° C) and average daily maximum (9° C) temperatures for salmonid spawning a majority of the sampling days (DEQ, 1995). These temperatures could postpone spawning or force the selection of less desirable redd location. Water temperature was not influenced by the amount of water discharged but rather the ambient air temperatures during low flows.

Information on other tributaries in the basin were acquired from the Targhee National Forest (Table 18). The Draft Forest Plan Revision and Environmental Impact Statement reported water quality in Big and Little Elk creeks was good in the 1970's, as was Rainey and Palisades creeks in a later 1994 study. The Forest Service also found Fall, Pritchard, Bear, Indian, and McCoy creeks had a good to fair rating in channel stability, but that Big Elk, Palisades, Rainey, Burns, and Pine creeks ranged from good to poor channel stability (Targhee National Forest, 1996a; Table 18). Impacts came mainly from recreational use, particularly in areas of dispersed camping, and from cattle grazing and roads. The lowest rated tributaries were Fall, Bear, and Antelope creeks (all of Fall Creek and lower half of Bear Creek). Fall Creek problems were attributed to cattle grazing, power line clearing, riparian roads and heavy recreational use, resulting in a fair rating for channel stability. On Antelope Creek, both the private and Forest Service lands were heavily impacted by roads, recreation, and cattle trampling.

Lakes and Reservoirs

Palisades Reservoir (elevation 5,620 ft.) is located on the Wyoming - Idaho border with most of the impoundment in Idaho. The shorelines are gravel and rock with mud flats in the upper reaches. The near shoreline slopes are primarily forested with meadows at the upper end. Despite summer drawdowns, the littoral zone of the reservoir is very narrow due to steep underwater slopes. This aspect tends to limit productivity and increase the capacity to absorb nutrient loading (Milligan, et al., 1983).

In a 1983 study of 85 lakes and reservoirs, Palisades was classified as mesotrophic with a Trophic Status Index (TSI) value of 16.8, indicating moderately rich in nutrients (Milligan, et al., 1983). (The TSI ranged from oligotrophic Redfish Lake with a TSI value of 7.6 to eutrophic Lake Lowell, near Caldwell, at 34.0; mesotrophic water bodies ranged from 16.5 to 18.1). The TSI took into consideration 11 parameters, including Chlorophyll a, organic content, total suspended solids, color, Secchi disc, turbidity, total phosphorus, total nitrogen, conductivity, alkalinity, and pH. Palisades Reservoir had a maximum depth of 32.3 meters, a Secchi disc depth reading of 3.5 meters, and a euphotic zone depth of 9.5 meters. The one-time sampling yielded a pH value of 8.0, hypolimnion dissolved oxygen level of 5.2 mg/l, fecal coliform count of 20 colonies/100 ml, total nitrogen of 0.19 mg/l, and total phosphorus of 0.04 mg/l. These values are all well within normal range and recommended limits.

Drewes (1991) reported that there is no indication Palisades Reservoir has any trophic or nutrient problems, but during runoff the waters received from the tributaries and released downstream do contain elevated levels of inorganic nitrogen. The reservoir is included in the Special Resource Water designation for the South Fork Snake River. Even though total phosphorus values were high in reservoir tributaries, as they were in the groundwater sampled near the reservoir (see following Ground Water discussion), it settled out or was utilized by reservoir plankton.

The 1985 Western Lakes Survey concluded that Upper Palisades Lake was in very good condition. This is typical for high elevation wilderness lakes which receive little impact other than seasonal recreation (Targhee National Forest, 1996a).

Table 18. Summary of South Fork Snake River Tributary Stream Conditions.

Tributaries	Intermittent or Permanent	Well-developed Riparian Communities (farming/grazing not close to stream)	Channel Stability (condition of stream beds and banks)	General Level of Water Quality *	Comments
McCoy Creek	Permanent		Good		
Bear Creek	Permanent	No	Fair		Half of creek has poor channel stability
Big Elk Creek	Permanent		Poor to Good	Water quality measured in 1970s good at that time	
Palisades Creek	Permanent		Poor to Good	Water quality measured by U.S. Forest Service in 1994 was good	
Indian Creek (river tributary)	Permanent		Good		
Fall Creek	Permanent		Fair		Entire creek has poor channel stability
Rainey Creek	Permanent	Yes	Good	2 (water quality measured by U.S. Forest Service in 1994 was good)	Problems with cattle & wildlife grazing impacts
Pritchard Creek	Permanent		Good		
Granite Creek	Intermittent	No	Poor	3	
Pine Creek	Permanent	Yes	Good	1	
Burns Creek	Permanent		Poor to Good		
East Birch Creek	Intermittent	No	Poor	5	
Antelope Creek	Intermittent	No	Poor	4	Private & U.S. Forest Service land impacted by roads, recreation, cattle trampling
West Birch Creek	Intermittent		Poor	6	

* The six tributaries evaluated in the Antelope - Pine SAWQP study were ranked (1 = least polluted; 6 = most polluted)

Source: Drewes, 1991; Targhee National Forest, 1996a.

Ground Water

Data available to date indicate ground water quality is good. The shallowness of the alluvial aquifer, geology, soils along the South Fork Snake River, and development pressures currently occurring in the basin have resulted in considerable concern about the quality of the ground water. The USGS National Water Quality Assessment Program reported that several wells tested along the main stem, from Palisades to the Henrys Fork confluence, had nitrate levels that were still < 2 mg/l (the federal drinking water standard is 10 mg/l) (Rupert, 1994). Samples taken from wells in the basin between 1992 to 1995 as part of the Idaho Statewide Ground Water Quality Monitoring Program found wells in Swan Valley had the highest nitrate levels of those sampled. However, they averaged 1.5 mg/l, well below the standard (Crockett, 1996).

With current and anticipated population growth in the Swan and Conant valleys, there is serious concern about the potential for pollution of the shallow alluvial aquifer, and ultimately the river, from septic systems installed at new developments (Dunn, 1996). Soil surveys done in Ririe, Conant Valley and Swan Valley identify severe limitations for absorption of pollutants from septic tanks and sewage lagoons (SCS, 1979 and 1981a).

Other Resource Values

TIMBER

Most timber harvest in the basin occurs under the direction of the Forest Service with the majority of forest lands under the jurisdiction of the Targhee National Forest. A small portion of the Caribou National Forest, encompassing the McCoy Creek watershed, is in the southern portion of the basin. About 101,000 acres, or 15 percent of the basin, are considered tentatively suitable for timber harvest. This comprises less than 1 percent of the total suitable timber found on the Targhee National Forest and Caribou National Forest. Suitable timber is determined by identifying lands that produce or are capable of producing crops of industrial wood by reviewing information on land coverage, slope, soil types, and aspect. Other criteria considered include: whether lands are withdrawn from entry by Congress, the Secretary of Agriculture or the Forest Service Chief; if current technology and knowledge indicates harvest can occur without irreversible impacts to soils and the watershed, and the site will revegetate within five years of harvest; and information exists to determine responses to timber management activities (Targhee National Forest, 1996b).

The Forest Plan Revision for the Targhee National Forest proposes timber harvest for some lands in the South Fork Snake Basin. Forest management would occur to improve forest health by reducing risk of insect and disease, and improving big game habitat. Small sales are proposed in the Elk Creek, Moody Creek, Burns-Pat creeks, McCoy-Jensen creeks, Fall Creek, and Brockman Creek watersheds over the next ten years. Less than 1,000 total acres are estimated for harvest with a total volume of 3,000 thousand board-feet in the basin (Targhee National Forest, 1996b). The Land & Resource Management Plan for the Caribou National Forest proposes harvest of 1.19 million board-feet for the time period 2001-2010 (Caribou National Forest, 1985). However, the Land & Resource Management Plan is currently being revised which may result in some changes (Moe, 1996).

MINES AND PROSPECTS

Currently very little mining activity occurs in the basin. Of eight mining claims, one is actively being pursued. The area has experienced periods of intense development and exploration for different minerals in the past. Gold exploration occurred from the 1870's to the late 1920's. In the mid-1980's the eastern half of the basin contained many oil and gas leases. Over the years exploration for other minerals has occurred.

Travertine - Eight mining claims in the basin are for travertine deposits located east of the Fall Creek drainage. One involves an active mine in the process of being patented. Although the

deposit is small (296.5 acres), it is a quality product and marketed internationally (Horsburgh, 1995). Travertine is a marble-like building material used in landscaping and adorning the exterior of buildings.

Phosphate - Deposits of the Meade Peak Phosphatic Shale Member of the Permian Phosphoria Formation occur within the basin. Although Idaho provides a small percentage of the world's phosphate, it is a major mineral commodity in the state, contributing about $80 million dollars annually to the economy. The phosphate industry is one of the top three in eastern Idaho. Phosphate is used to produce fertilizers and phosphoric acid.

Rich deposits are located in the Caribou Range Known Phosphate Leasing Area west of Swan Valley (Figure 14). Four phosphate leases for the area date from 1929 with an estimated 10-20 year supply (Horsburgh, 1995). The last reported activity occurred in the 1960's as part of exploration (Forest Service, 1996a). Economic conditions have not resulted in mining of these deposits, and will likely not occur until deposits in the Soda Springs area are exhausted approximately 50-70 years from now (Horsburgh, 1995). Other phosphate deposits have been identified throughout the basin and are depicted in Figure 14 (Idaho Bureau of Mining and Geology, 1981).

Oil and Gas - An inventory of oil and gas potential completed in 1992 indicates the possibility of discovering oil or gas is high within portions of the basin (Horsburgh, 1992). The basin lies in what is known as the overthrust belt, a thick sequence of sedimentary rocks which were folded and faulted. The thrust sheets have overridden each other in a west to east direction.

The area north of the South Fork Snake River from Pine Creek east has a high potential. The geologic setting of this area is similar to producing fields found in adjacent Utah and Wyoming characterized by asymmetric folds in the leading edges of major thrust plates. The area north of the South Fork Snake River and west of Pine Creek has a moderate potential. The remainder of the basin has little or no potential (Horsburgh, 1992). See Figure 14.

Exploratory wells were drilled in Mike Spencer Canyon, Swan Valley, Bald Mountain and Black Mountain in the mid-1980's, but were not successful. Commercial market conditions have resulted in no recent oil and gas exploration. Oil industry representatives have indicated that exploration in Idaho will likely not occur until the value of oil remains above $30 a barrel (Horsburgh, 1992).

Gold - Historically, commercial gold mining occurred on Caribou Mountain in the McCoy Creek drainage from the 1870's to 1920's (Jones, 1996). The area is covered by lode and placer claims for gold. Today recreational gold dredging, sluicing and panning occur.

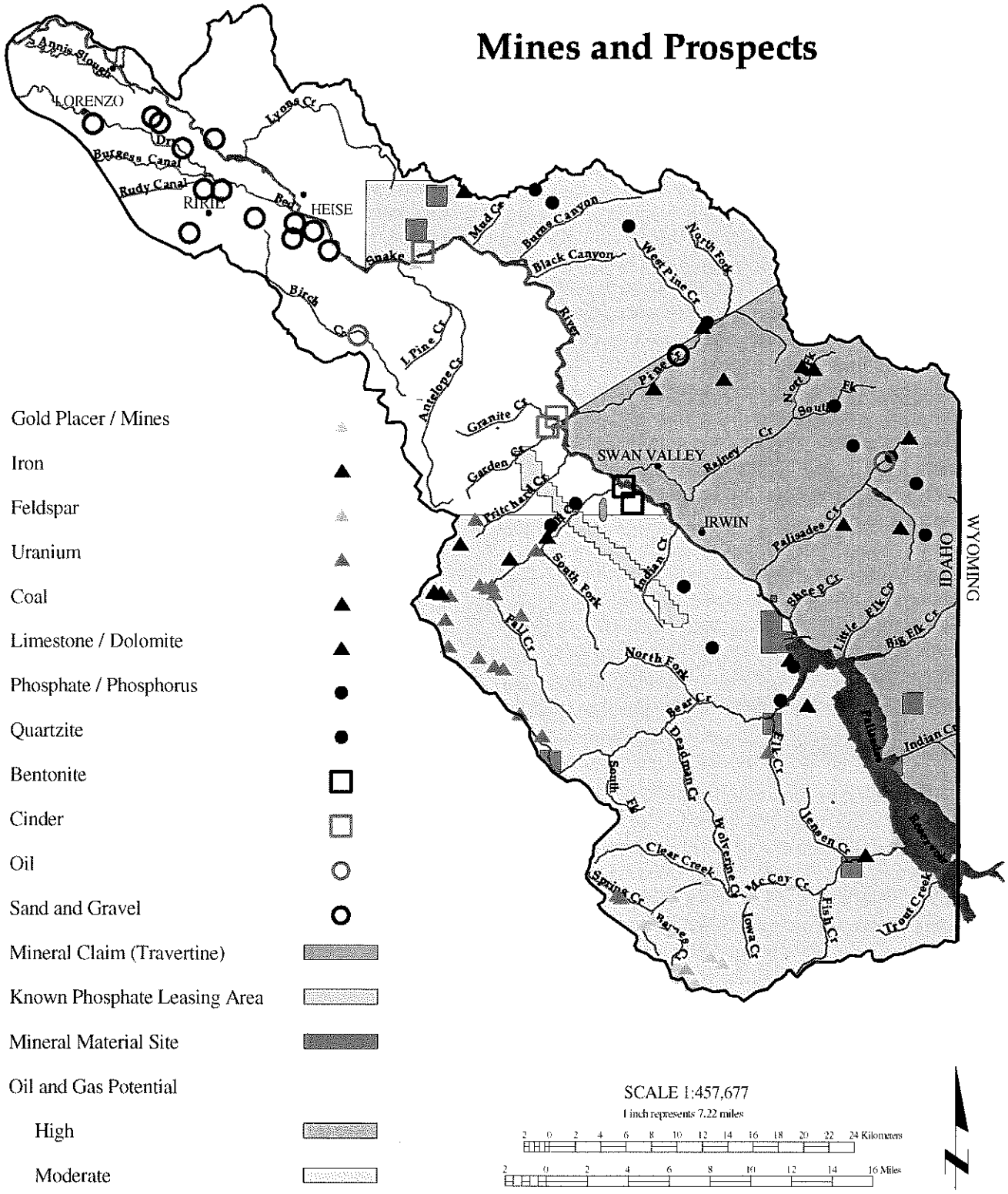
Impacts from recreational dredging were significant enough to require closing McCoy Creek to use under a simple one stop permit system. Individuals must now apply for a stream channel alteration permit from the Idaho Department of Water Resources and a special use permit from the Forest Service (Verner, 1995). Activity is limited to five individuals a year and is closed to all activity from May 1 to September 1 to protect spawning cutthroat (Jones, 1996).

Mineral Material Sites - Ten mineral material sites are located in the basin. These are sites with mineral deposits of economic value that may be used for agriculture, building material, cleaning and abrasive materials, construction, decorative arts, and landscaping. The materials may be removed by securing a permit from the Forest Service or BLM. Sites within the basin contain sand, gravel and cinders. Materials from these sites are mainly used by local government entities for road maintenance and construction (Horsburgh, 1995).

Exploration in the basin has identified several other mineral prospects including uranium and

Figure 14

Mines and Prospects



iron in the headwaters of the Fall Creek drainage, and limestone and dolomite deposits throughout the basin (Idaho Bureau of Mining and Geology, 1981). Low grade coal deposits occur throughout the basin, but are not economically viable (Gillerman, 1995) Feldspar, quartzite and bentonite have also been identified. Figure 14 depicts the general locations of these deposits.

NAVIGATION

There is no commercial navigation, defined as moving commodities by water, on the South Fork Snake River reach from the Idaho-Wyoming state line to the Henrys Fork confluence. Under the Idaho Admissions Act and Idaho Constitution, the State claims title to all bodies of water that are navigable. Under this claim a stream must have been used as a "highway for commerce" on the date that the State of Idaho was admitted to the Union (July 3, 1890). State title applies to the South Fork Snake River in the basin (Idaho Department of Lands, 1986).

Outfitters use the South Fork Snake River for commercial floating and fishing expeditions. To date, eight outfitters are licensed to operate on the South Fork Snake River by the Idaho Outfitters and Guides Licensing Board. This activity is discussed in the *Recreation* section.

FISH AND WILDLIFE

In 1980, the South Fork Snake River was identified as the most important fish and wildlife habitat in Idaho and one of the most significant in the western United States (U.S. Department of Interior, Fish and Wildlife Service [USFWS], 1986). There are several key features that make the river so biologically important and unique. Throughout the length of the free-flowing section, the river flows though the most extensive and highest quality cottonwood forest in Idaho (Riggin and Hansen, 1992). Secondly, fish productivity in the South Fork Snake River is high, and supports one of the few remaining native cutthroat trout fisheries (Thurow, et al., 1988). These features, plus the resident bald eagle population and breeding bird diversity, set the river and its basin apart from many others in western North America.

Ecosystems

The biodiversity in the basin is high, in large part because of the uniqueness of the South Fork Snake River narrowleaf cottonwood community (Saab, 1991). (Biodiversity defines biological species diversity measured by determining the total number of species in a community and the relative abundance of the species.) The South Fork Snake River narrowleaf cottonwood forest is the most productive habitat type in the basin for species diversity (BLM and Forest Service, 1991). The construction of Palisades Reservoir resulted in the loss of significant riverine and riparian habitat for aquatic mammals (mink, otter), elk, mule deer, breeding waterfowl, ruffed grouse, bald eagle, and nongame birds. The osprey is the only terrestrial vertebrate known to have benefitted from the reservoir (Meuleman, Martin and Hansen, 1992).

Riparian communities are the most important habitats in North America for solitary nesting birds, and critical for migrating birds (Schroeder and Allen, 1992). Data collected by the Targhee National Forest found three of the twelve communities on the forest had the majority of species occurring in or adjacent to the riparian community (Targhee National Forest, 1993). This included 62 of 85 mammals, 262 of 301 birds, and 13 of 17 amphibians and reptiles. Another study found sixty-seven percent of the 126 total riparian species utilizing the river riparian corridor were neotropical bird migrants (Meuleman, et. al., 1986).

The tributaries to the South Fork Snake River provide important foraging and nesting habitat, and refugia for wildlife in the basin. While the tributary riparian communities do not possess the extensive mature narrowleaf cottonwood gallery forest, and therefore, within-community heterogeneity that the main stem does, they often present mosaics of greater between-community heterogeneity. Tributary habitat will become more critical as human use and activity on the main stem increases.

The South Fork Snake River below Palisades Dam represents the largest continuous stand of narrowleaf cottonwood *(Populus angustifolia)* forest in the state and entire intermountain region (Saab, 1991; Riggin and Hansen, 1992). However, forest age composition of the South Fork Snake River corridor indicates insufficient numbers of young cottonwood to replace mature cottonwood (BLM and Forest Service, 1991). Inventories conducted in 1982 and 1988 determined 84 percent of the cottonwood population was mature or older trees (41 years or older), and the remaining 14 percent were young trees (Aslett, 1982; BLM and Forest Service, 1991). The establishment of immature trees on gravel bars and disturbed areas is not sufficient because flow releases have reduced the amount of sediment scouring, channel shifting and deposition. Total recruitment on gravel bars and sucker growth in mature stands will probably decline in area and vigor over the years (Merigliano, 1996).

Merigliano studied cottonwood stands from Palisades Dam to Heise to examine changes to the forest structure and composition from the 1950's to the present (Merigliano, 1994). His study found that as the stream channel became entrenched, it confined the cottonwoods to a denser, but narrower band. Merigliano concluded the pre-settlement/pre-dam cottonwood ecosystem is similar today in composition and structure, but stands are significantly smaller. The last major episode of cottonwood recruitment occurred in the mid-1940's before Palisades Dam was constructed. Cottonwood regeneration is dependent on occasional flooding, possibly of the magnitude and frequency of 36,000 cfs every 10-15 years (Merigliano, 1996). Planting is considered the least desirable option because of expense, access, rocky soils, irrigation, and beaver depredation.

In addition to the narrowleaf cottonwood dominance, the South Fork Snake River streamside riparian community also includes water birch, red-osier dogwood, silverberry, sandbar willow, yellow willow, and bentgrass (Merigliano, 1994). Narrowleaf cottonwood dominates the canopy, but the red-stemmed dogwood has the highest understory density (Saab, 1992). Other species included in the riparian community of the South Fork Snake River and its tributaries are Douglas fir, lodgepole pine, wild rose, and western serviceberry.

The east side tributaries (Indian, Big Elk, Palisades, Rainey, Pine, and Burns creeks) tend to be lusher and less xeric than the west side tributaries (McCoy, Bear, Indian, Fall, Pritchard, and Antelope creeks), in part because of the geology and topography of the canyons (tight and narrow on the east side, wider and more open on the west side). The Bear Creek riparian community, typifying the west side tributaries, is dominated by sandbar willow, alder, dogwood, and Douglas fir, with more open sagebrush-aspen complexes along the stream at higher elevations.

Burns Creek canyon, an east side riparian community in excellent, near pristine condition, has certain vegetation types which are uncommon for this part of Idaho (Layser, 1994). The community types exhibit exceptional diversity of species and structure. The upper Burns Creek canyon consists of shrub and tree dominated communities of white alder, water birch, red-osier dogwood, alder, and sandbar willow with Rocky Mountain maple, ninebark, and bigtooth maple common in places. Also found are Hudson Bay currant, black hawthorn, chokecherry, Douglas fir, subalpine fir, horsetail, Engelmann spruce, and narrowleaf cottonwood scattered throughout. The lower reach is dominated by stands of large narrowleaf cottonwood with a multi-layered, structurally diverse, deciduous tree and shrub understory of western birch, red-osier dogwood, and bluegrass. It is unusual for species such as water birch, bigtooth maple, ninebark, and hawthorn to extend as far up a tributary as they do in Burns Canyon, providing a connection between the South Fork Snake River and its uplands. The 490-acre Burns Canyon Research Natural Area was recently designated by the Intermountain Regional Forester indicating the significance of this community.

Cress Creek is unique among the tributaries, because it is a spring-fed riparian system

(Kotansky, 1996). Originating on the northern bench of the lower South Fork Snake River downstream from Heise, the stream has excellent water clarity and quality for all parameters, except fecal coliform bacteria (Kotansky, 1996). The high water quality supports a healthy, highly-structured riparian ecosystem with a number of different hydrophytic marsh species such as narrowleaf cottonwood, water birch, water cress, cattail, and monkeyflower within a few feet of semi-arid upland species of predominantly juniper, bluebunch wheatgrass, big sagebrush, slender wheatgrass, arrowleaf balsamroot, and antelope bitterbrush.

A plant listed as threatened under the Endangered Species Act occurs in the basin. A species of orchid, Ute ladies' tresses (*Spiranthes diluvialis* - which means "of the floods") was found in the fall of 1996 in four active riparian zones, or flood channels, of the South Fork Snake River (Moseley, 1996). The four populations were found between Fall Creek Campground and Kelly Island Campground, a distance of about 40 river miles. The orchid is also distributed in Colorado, Montana, Wyoming, Utah and Nebraska on the fringes of flood channels, but well within the riparian community.

The uplands above the riparian community are dominated by Douglas fir, quaking aspen, juniper, and sagebrush. Douglas fir and quaking aspen dominate the north-facing slopes; juniper and sagebrush dominate the south-facing slopes (BLM and Forest Service, 1991).

Numerous invasive plant species occur in the basin, including several knapweeds (*Centaurea* spp.), common tansy (*Tanacetum vulgare*), Canada thistle (*Cirsium vulgare*), purple loosestrife (*Lythrum salicaria*), leafy spurge (*Euphorbia esula*), and musk thistle (*Carduus nutans*) (U. S. Department of Energy, Bonneville Power Administration [BPA], 1995). Riparian ecosystems in the west are seriously threatened by these exotic invasions, caused by soil and habitat disturbances and non-native introductions. Agencies and counties are working cooperatively in the basin to prevent further invasion and spread, using integrated pest management techniques.

Fisheries

Eleven species representing four families occur in the main stem (Thurow, Corsi, and Moore, 1988). The native fish species include the cutthroat trout, mountain whitefish, mountain sucker, bluehead sucker, Utah sucker, Utah chub, redside shiner, longnose dace, speckled dace, mountain sculpin and Paiute sculpin. The most abundant game fish in the South Fork Snake River are mountain whitefish (*Prosopium williamsoni*) which are an important food source for bald eagles. Species introduced to the basin include rainbow, brook, brown, and lake trout, kokanee and coho salmon.

The South Fork Snake River is an important cutthroat trout *(Oncorhynchus clarki*) and brown trout (*Salmo trutta*) fishery (Schrader and Griswold, 1994). Its importance is associated with high growth rate and natural reproduction (Martin, 1996). Special IDFG fishing regulations, high densities and low mortality rates also contribute to the outstanding fishery condition. In a comparative study with eight other Idaho cutthroat streams, the South Fork Snake River ranked second only to the main Snake River in measured length at 4 years of age (Schill, 1991).

Although unresolved, some biologists believe two subspecies of cutthroat trout exist in the basin -- Yellowstone cutthroat and Snake River fine-spotted cutthroat (Behnke, 1992). The Yellowstone cutthroat exists in the basin as both migratory and non-migratory populations. The nonmigrants spend their entire life in the tributaries. The migrants move into the tributaries from the main stem to spawn and then return to the main stem (Thurow, Corsi, and Moore, 1988). The Yellowstone cutthroat trout has evolved with little interspecific competition, and has consequently developed a relatively broad niche in terms of feeding habits and habitat utilization (Targhee National Forest, 1993). Both subspecies are found throughout much of the basin, but the Yellowstone cutthroat is the

dominant subspecies in the South Fork Snake River and tributaries, while the fine-spotted cutthroat dominates above Palisades Dam in the reservoir and tributaries (Thurow, 1996; Figure 15). Palisades Dam, completed in 1957, created a flatwater lacustrine environment that effectively eliminated migration of cutthroat from the South Fork Snake River below the dam to tributaries to the reservoir (Thurow, Corsi, and Moore, 1988). Some fish still move downstream from the reservoir.

The Yellowstone cutthroat and fine-spotted cutthroat trout are listed as Species of Special Concern by the IDFG. Species of Special Concern are native species which are either low in numbers, limited in distribution, or have suffered significant habitat losses (IDFG, Conservation Data Center [CDC], 1994). Historically, the Yellowstone cutthroat occupied 3,797 miles of riverine habitat within Idaho (Duff, 1996). Current assessment indicates that approximately 1,622 stream miles are presently inhabited by Yellowstone cutthroat, or 43 percent of their original historic range. However, only a small percentage of this population has been genetically verified. There is concern that the genetic purity of many of these populations may be contaminated by rainbow trout hybridization. Of the twenty-one sub-basins with Yellowstone cutthroat trout in Idaho, nineteen (including the South Fork Snake River Basin) contain exotic trout species such as rainbow which threaten the genetic purity of the Yellowstone cutthroat species.

Thirteen tributaries to the main stem are considered biologically significant, because they are perennial with known cutthroat spawning. McCoy, Bear, Indian, and Big Elk creeks flow into Palisades Reservoir and are considered important spawning tributaries (Moore, Aslett, and Corsi, 1981). Palisades, Rainey, Pritchard, Pine, and Burns creeks are important spawning tributaries to the main stem. Dean (1996a) reported that healthy, stable reproducing populations of cutthroat exist in McCoy, Bear, Palisades, Pine, and Burns creeks.

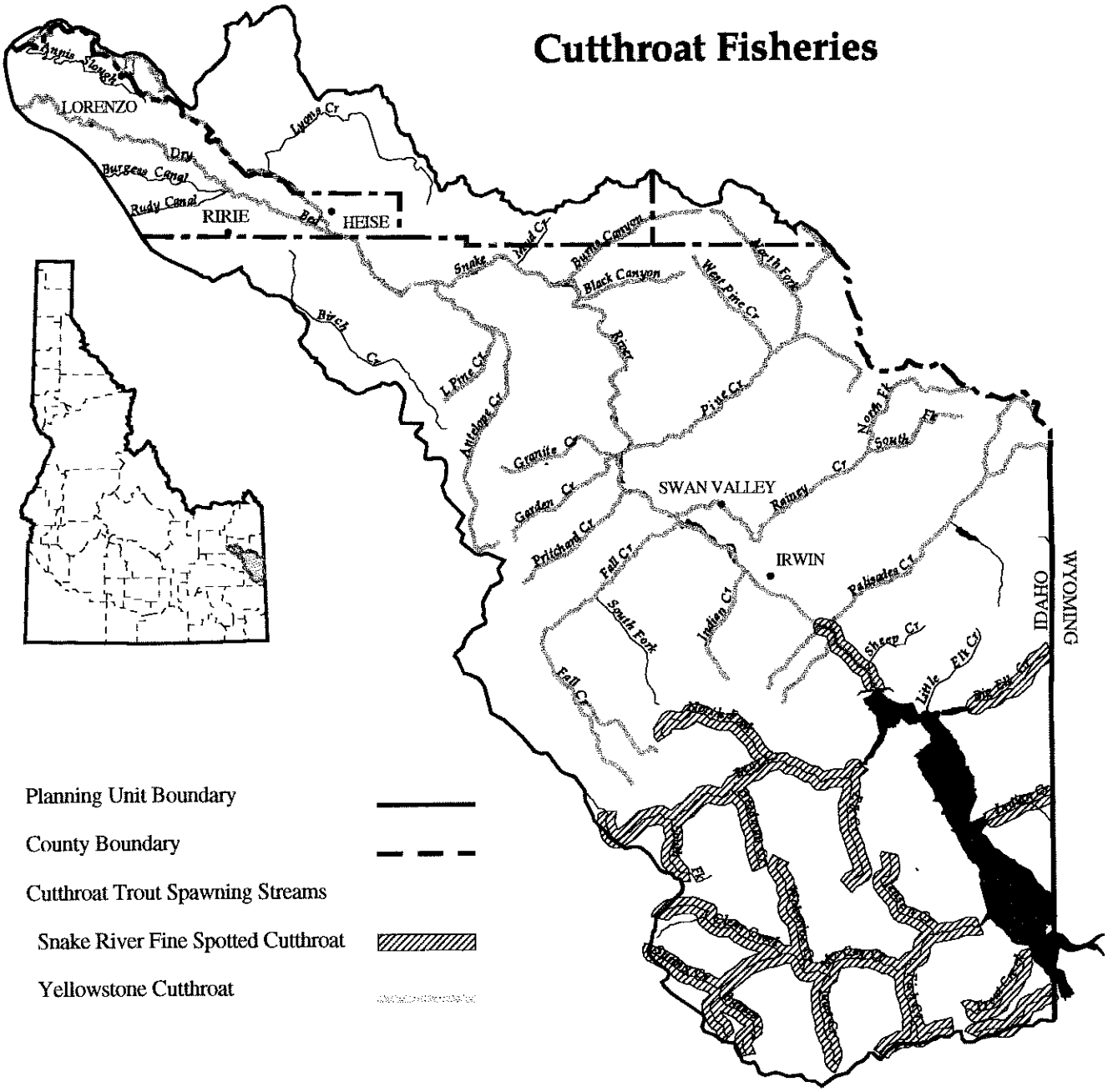
Threats to many of the spawning tributaries limit recruitment to the main stem fishery. Palisades Creek, the uppermost tributary to the South Fork Snake River, has excellent spawning and rearing potential, but 95 percent of the water is diverted one kilometer above the mouth during irrigation season (Moore, 1980). Currently, a bypass system is operated to increase migratory success. Indian Creek is severely degraded by cattle (Moore, 1980). The Fall Creek Yellowstone cutthroat population has been isolated for almost two million years because of a ten meter waterfall at the mouth (Dean, 1996b). Consequently, the thriving population of cutthroat trout may well be a unique subspecies. Rainey Creek is dewatered at times because of a porous alluvium in the upper section and five diversions in the lower section. Degradation occurs in lower Rainey Creek from dewatering and siltation. Springs recharge it before entering the South Fork Snake River. Pine Creek, including its three forks, is the largest tributary to the main stem used by spawning trout. The low gradient, upper reach flows through a flat valley and has a good riffle-pool structure. Some impacts occur from grazing. Antelope Creek drains an area with intense agriculture which has impacted the water quality and habitat in the lower section. The headwaters provide adequate habitat for spawning and rearing, supporting a self-sustaining population of resident trout. Burns Creek is considered to be the most important spawning tributary below Palisades Dam.

Despite the threats identified, all of these tributaries are considered by the IDFG to be important cutthroat trout spawning tributaries (Martin, 1996). An additional threat to the basin cutthroat fishery is the hybridization with rainbow trout, jeopardizing the viability of the native cutthroat population and fishery (Martin, 1996). The IDFG currently is radio-tagging rainbow trout to determine their current distribution in the basin.

Brown trout were introduced into Idaho in 1892. The species were not planted by IDFG into the South Fork Snake River Basin until 1968,

Figure 15

Cutthroat Fisheries



although the species were already present in 1955, comprising 5 percent of all trout samples. In 1979, brown trout represented 9 percent of the angler catch. From an economic perspective, they are of major importance in the South Fork Snake River drainage, providing anglers with an opportunity to catch "trophy-sized" fish. The official state record of 26.4 pounds was taken below Palisades Dam in 1981 (Martin, 1996). A study of juvenile Yellowstone cutthroat, brown trout, and mountain whitefish in the main stem found the winter density of cutthroat trout was the highest of the three species, brown trout was the lowest (Schrader and Griswold, 1994).

During the winter, the sub-yearling cutthroat and brown trout are most abundant in the side channels of the South Fork Snake River where cover and habitat occur. Available winter habitat is associated with river discharge (Schrader and Griswold, 1994). Recent research indicates a minimum flow of about 1500 cfs from October 1 to March 30 is needed to reduce juvenile mortality (Schrader and Griswold, 1994). The greatest loss of juvenile cutthroat and brown trout occurs at flows between 1540 to 1240 cfs, because the greatest number of habitats become unavailable as they dry up or freeze (Schrader and Griswold, 1994).

Wildlife

Wildlife habitats mapped for the basin include areas where selected wildlife are dependent to maintain their populations during critical times of the year (Figure 16). This includes crucial wintering ranges for elk and/or mule deer, white-tailed deer, mountain goat; nesting territories for heron rookeries; and bald eagle principal management parcels (Martin, 1996; Naderman, 1996; Whitfield, 1993; Hayden, 1989; CDC, 1996; BLM and Forest Service, 1991).

Mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) use all South Fork Snake River Basin habitats in the spring, summer, and fall, and the sagebrush-wheatgrass and forested habitats of the foothills and river corridor in the winter (BPA, 1995; Gardetto, 1996). Both species prefer higher elevations, but snow depths force them to lower elevations in the winter, mainly south facing slopes with lower snow depths. Mountain goats tend to concentrate on the more precipitous east side of the river, while mule deer and elk on the more open west side. Whitetail deer reside mainly in the floodplain of the main stem. Moose occur throughout the basin.

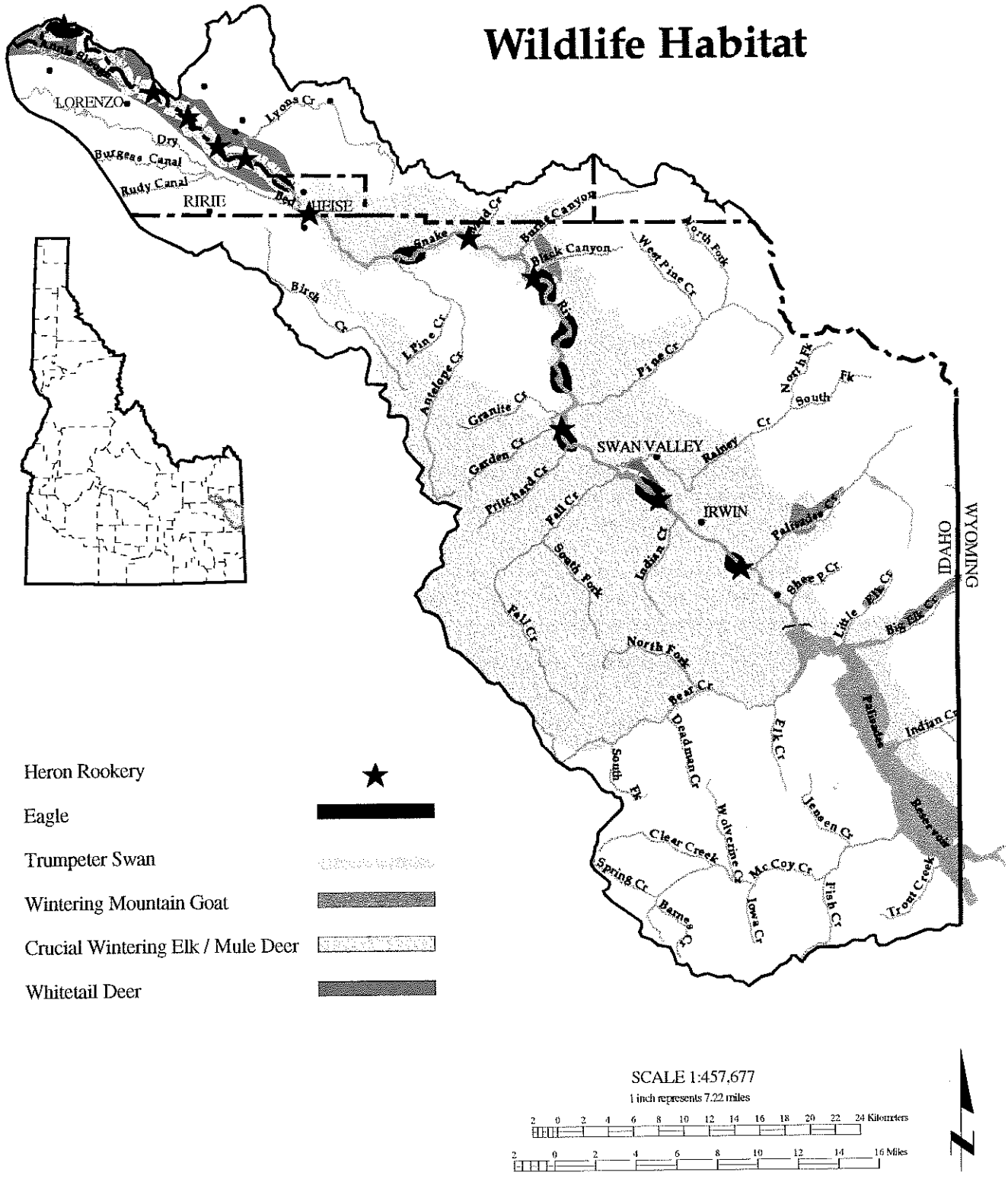
Canada geese (*Branta canadensis*) use the South Fork Snake River corridor for wintering, nesting and brood rearing (BPA, 1995). The river corridor has been identified as one of the most important nesting areas in the region (Krohn and Bizeau, 1980, cited in BPA, 1995). Canada geese primarily nest on the approximately 260 islands occurring on the South Fork Snake River between Palisades Dam and the Henrys Fork confluence. Between 1972 to 1979, the IDFG studied nesting success and found it depended on the magnitude and timing of spring releases (IDFG, 1979; Riggin and Hansen, 1992). Flows between 8000-16,000 cfs from March to May increase goose nesting success (Cochnauer and White, 1975). Flows below 8000 cfs allow nests to suffer from predation (Parker, 1973). Flows greater than 16,000 cfs inundate the nests. However, the IDFG believe that fish, stream channel, and riparian needs outweigh goose nesting needs when water is in short supply (Martin, 1996).

The South Fork Snake River is also used as a migratory wintering area by the trumpeter swan (*Cygnus buccinator*) (IDFG, 1994; Figure 16). Winter habitat requires ice-free waters, usually occurring where springs feed into the river, supporting abundant aquatic plant forage species such as pondweed, waterweed, duckweed, and water milfoil (BPA, 1995).

The northern goshawk (*Accipter gentilis*) nests in at least two locations in the basin. Goshawks typically locate their nests on gentle to moderate slopes with northern aspects adjacent to springs or streams (Reynolds, 1983, cited in BPA, 1995). Goshawks usually remain as residents once they have established nests.

Figure 16

Wildlife Habitat



Recently, the USFWS modified the process to list threatened and endangered species (*Federal Register*, February 28, 1996). Currently, there are only two species of animals listed as threatened or endangered in the South Fork Snake River Basin -- the peregrine falcon (*Falco peregrinus anatum*) is listed as endangered and the bald eagle (*Haliaeetus leucocephalus*) as threatened (IDFG, Conservation Data Center 1996). The peregrine falcon has historically nested on the South Fork Snake River cliffs (BLM and Forest Service, 1991). For nesting the birds need a combination of steep vertical surfaces to prevent predation, and ledges and cracks for scrapes and roost sites (Kilpatrick, 1987, cited in BPA, 1995). Typical nesting habitat is cliffs between 100 to 300 feet high, but rarely above 8500 feet (2590 meters) in elevation. The USFWS has attempted to restock peregrines in the South Fork Snake River corridor using birds from the Peregrine Fund in Boise. Presently, two active natural eyries are found in the corridor (Gardetto, 1996).

The entire upper Snake is regionally important as a critical bald eagle nesting and winter area (Riggin and Hansen, 1992). In 1967, no eagles were known to nest along the river. By 1982, there were ten breeding pairs. In 1986, 35 percent of all eagles nesting in Idaho nested in the South Fork Snake River Basin. (Greater Yellowstone Ecosystem Working Team, 1983; Swenson, et al., 1986; Meuleman, et al., 1986). In 1992, eleven nesting pairs and sixty wintering birds were identified in the basin (Martin and Hansen, 1992). Currently there are twelve nests in the basin; eleven occur on public land (Gardetto, 1996). The South Fork Snake River Basin currently contributes 50 percent of the total bald eagle production in Idaho and accounts for more than 30 percent for the Greater Yellowstone Ecosystem (BLM and Forest Service, 1991).

Bald eagles nest in large, prominent trees in multi-layered forest stands, usually in large conifers and cottonwood trees (DeGraff, et al., 1991, cited in BPA, 1995). Nesting territories are occupied annually, as long as an adequate breeding population exists. A pair of eagles may return to the same nest for many years if the location is near an adequate food source, such as fish, waterfowl, and rabbits (Paige, et al., 1990, cited in BPA, 1995). In the Greater Yellowstone Ecosystem, 45 percent of bald eagle nests occur in narrowleaf cottonwood with the remainder in blue spruce, Douglas fir, lodgepole pine or Engelmann spruce (Swenson, et al., 1986). Ten of eleven nests in the basin are found in cottonwoods, mostly large, old trees.

For foraging purposes, most eagle nests are placed near important spawning tributaries for cutthroat trout and Utah suckers, because the main stem may be silt-laden with spring runoff (Swenson, et al., 1986). Bald eagles forage in the tributaries, especially when the South Fork Snake River is frozen, but they rely predominately on the main stem when accessible. On the South Fork Snake River, both cutthroat trout and whitefish provide abundant food for bald eagles (Sather-Blair and Preston, 1985, cited in BPA, 1995). Low winter flows that cause extensive and prolonged icing negatively affect fish populations and impact the eagles as well.

In 1983, it was estimated that 72 percent of the existing nesting population of eagles could be impacted unless adequate management practices were applied (Greater Yellowstone Ecosystem Working Team, 1983). There are four nests that are seriously threatened by current and potential development in the vicinity of Palisades Creek, Swan Valley, Conant Valley, and Antelope Creek (Whitfield, 1996). Habitat for bald eagles was prioritized for protection from Palisades Dam to the confluence. Reaches closest to the dam were given the highest priority for protection, because of the imminent threat from development (Martin and Hansen, 1992).

Vertical vegetation stratification, plant species richness, and special habitat features such as snags are frequently related to bird species abundance in the riparian habitat. A study conducted from 1991 to 1994 studied the patterns of habitat use by breeding birds in cottonwood riparian forests along the South Fork Snake River from Palisades Dam to the Henrys Fork confluence (Saab, 1994). Bird distribution and abundance and vegetation data were collected for

57 cottonwood forest patches. Habitat conditions studied ranged from relatively undisturbed areas to areas used for livestock grazing and/or recreational activities.

Ninety-seven species were recorded in the study with 78 percent of them migratory (Saab, 1994). Preliminary results indicate species richness was slightly higher in undisturbed areas (82 species) than in grazed (79 species) or recreational sites (60 species). Bird abundance and species richness were greater in relatively undisturbed cottonwood patches with a greater diversity and density of shrubs and ground cover than that found in disturbed patches. Large cottonwood patches surrounded by natural landscapes had higher species richness than small cottonwood patches surrounded by agricultural landscapes.

Species composition was equally similar between grazed and recreation use sites (81 percent) and between undisturbed and grazed sites (81 percent), while undisturbed and recreational sites were the least similar (75 percent). Cottonwood forests in the reaches of the river that possessed the higher bird diversities, such as the canyon portion (Conant Valley to Black Canyon), tended to be more connected, large stands and have a greater mosaic of vegetative communities in the surrounding landscape.

Saab's (1996) study of breeding birds recommended that land acquisitions focus on large cottonwood patches surrounded by natural landscapes to maintain species richness of native birds. Maintaining large cottonwood patches is also critical for the long-term persistence of habitat interior species. Whereas, small fragments of riparian habitat are important for attracting the habitat edge specialists. Avian nest predators such as crows, magpies and starlings, and avian brood parasites persist with urban and rural development, and are potential threats to breeding bird productivity as land use development occurs.

In a recent publication, Frest (1994) reported several locations where springsnail mollusks, a Species of Special Concern, are found in the South Fork Snake River Basin. The sites and genera include Cress Creek Spring (*Physella, Oxyloma*), Kelly Canyon springs (*Lyogyrus, Physella*), Hawley Gulch springs and runs (*Lyogyrus*), Mud Creek (*Physella, Oxyloma, Deroceras*), Warm Springs complex (*Pyrgulopsis, Physella*), Wolverine Creek (*Lyogyrus*), Spring Creek (*Physella*), and McCoy Creek and tributaries (*Stagnicola, Physella, Lyogyrus*). Frest (1995) recommended that several of these species warrant listing under the Endangered Species Act, including *Lyogyrus spp.* and *Pyrgulopsis spp.*

RECREATION

The *Recreation* section is a summary of inventory information obtained while preparing the South Fork Snake River Basin Plan. More information is provided in the Recreation Technical Report located in IDWR files. Several federal, state, county and local entities manage lands and facilities providing recreation opportunities in the basin. Primary recreation providers are the Targhee National Forest, Caribou National Forest, and Idaho Falls District BLM. The USBR has facilities below Palisades Reservoir. Additional opportunities are available at sites managed by IDFG, Bonneville, Madison and Jefferson counties, and private entities.

Recreation use in the basin by activity is summarized in Table 19 by regional participation and agency. This table does not provide a complete quantification of recreation use, because much of the use occurs as dispersed use or through private entities which is difficult to assess. (Dispersed use is activity that occurs outside developed facilities.) The information does provide a general description of the composition of recreational activities that occur in the basin compared to regional participation. Because a recreation visit is estimated for each activity that an individual participates, the use estimates do not represent total numbers of individuals recreating in the basin.

Table 19. Estimated Recreation Activity Participation for Region 6 and the South Fork Snake River Basin.

Activity	REGION 6[1] PARTICIPATION		Bureau of Land Management	Bureau of Reclamation	U. S. Forest Service
	Resident Travelers	Non-res. Travelers	1994 RVs[2] (% of total)	1994 Rvs	1994 RVS (% of total)
Fishing	10.7%	8.0%			
Reservoirs					200 (0.01%)
Rivers			81,020 (28.2%)		196,300 (7.0%)
Ice					10,800 (0.4%)
Boating	5.3%[4]	2.6% [4]			
Canoe					9,400 (0.3%)
Sailboat					2,200 (0.1%)
Other non-motorized			74,950 (26.1%)		21,400 (0.8%)
Motorized boating			65,250 (22.7%)		43,000 (1.5%)
Tour/Ferry					1,000 (0.04%)
Other Water-based					
Swimming	2.3%				17,700 (0.6%)
Water skiing/Diving	1.0%				19,800 (0.7%)
Camping	5.3%	9.1%	19,400 (6.7%)		450,800(16.0%)
Organization Camps					105,400 (3.7%)
Hunting	3.0%				155,300 (5.5%)
Big Game			3,790 (1.3%)		
Waterfowl			1,250 (0.4%)		
ORV Travel	1.5%	0.6%	2,750 (1.0%)		64,300 (2.3%)
Other Motorized					445,100(15.8%)
Non-motorized					
Hiking	45.8%		5,700 (2.0%)		48,800 (1.7%)
Biking	6.9%		1,250 (0.4%)		14,700 (0.5%)
Horseback			1,250 (0.4%)		34,000 (1.2%)
Other Land-based					
Picnicking	5.3%		15,050 (5.2%)		78,600 (2.8%)
Nature study			13,250 (4.6%)		84,900 (3.0%)
Sightseeing	6.9%	17.5%			311,200(11.1%)
Tours					54,200 (1.9%)
Sports					36,800 (1.3%)
Recreation cabins					34,400 (1.2%)
Gather forest products					77,700 (2.8%)
Winter Sports			1,250 (0.4%)		307,500(10.9%)
Skiing	4.6%				
Snowmobile	2.3%				
Snowplay	1.5%				
Other			1,250 (0.4%)		188,400 (6.7%)
TOTAL RVs			**287,410**	**11,049[3]**	**2,708,900**

[1] Region 6 includes Bonneville, Clark, Fremont, Jefferson, Madison and Teton counties.
[2] RV - Recreation visit equals one person for one visit regardless of length of visit. Each activity a person participates is counted as one recreation visit. Therefore, total recreation visits do not estimate total numbers of people recreating.
[3] Indicates visitation at the Bureau of Reclamation site below Palisades Dam only. Visitation at facilities located on Palisades Reservoir are included in the U. S. Forest Service estimates.
[4] Water skiing is included under boating.

Sources: Parrish et al., 1996; Hunt et al., 1994; Targhee National Forest, 1995; Bureau of Land Management, 1995; Brown, 1995; Daniels, 1995.

The basin supports a wide diversity of recreation settings and experiences ranging from natural, undeveloped settings to areas with facilities. Most developed facilities are located within the South Fork Snake River corridor and include campgrounds, boat access and picnic facilities. Figure 17 depicts developed facilities and important recreation areas in the South Fork Snake River Basin.

The South Fork Snake River corridor is the focus of much concentrated recreation use. The Idaho Falls District BLM estimates 225,000 recreation visits in the South Fork Snake River corridor from Palisades Dam to the Henrys Fork confluence in 1995 (Brown, 1996). The composition of recreation activities in the river corridor is illustrated in Figure 18, page 58. Estimated hours fished during the summer has more than tripled since 1982 from 53,676 hours to 169,142 hours in 1996 (Moore and Schill, 1984; Schrader, 1996).

Public land occurs along most of the length of the river, theoretically providing extensive access (with the exception of private land in the Swan Valley area.) However, access is limited in some areas, because of the steep-walled canyon, dense vegetation, lack of roads, or private lands obstructing access to adjacent public lands.

Despite these limitations, several developed access points are located along the river. These include eleven boat access facilities, Kelly Island campground operated by the BLM, and Twin Bridges campground operated by Madison County (Figure 17). Seven boat access facilities are improved with concrete ramps. The remainder are unimproved bank launches. Additional access is possible by roads paralleling the river. Sections of Forest Service Road 058 parallel the river between Irwin and Fall Creek Falls. The Snake River Road (Forest Service Road 206) parallels the north side of the river from Black Canyon to below Wolf Flat. Estimated visits for access sites along the river managed by BLM are presented in Table 20.

To protect bald eagle nesting areas, heron rookeries, and improve vegetation and other wildlife resources, camping in the South Fork Snake River canyon (Conant to Black Canyon) is now restricted to designated camping areas (BLM and Forest Service, 1991). These designated areas are located in the vicinity of Pine Creek, Dry Canyon and Gormer Canyon, and are depicted in Figure 17.

Observation of recreation patterns over the past three years have identified some changes and trends in recreation use in the corridor. Recreation visits have increased significantly on the river in the reach below Heise. Personal water crafts (jet skies) are appearing in greater numbers. Guided fishing trips have increased. Anglers are not the only people floating the river -- more people are floating to enjoy the scenery. More people are camping in the canyon reach (Conant Valley to Black Canyon). In 1995 an estimated 713 people camped in the canyon (Brown, 1996).

The South Fork Snake River has a reputation for its native cutthroat fishery, and is nationally recognized as one of the top 100 trout fishing streams in America (Pero and Yuskavitch, 1989). The value of fishing and associated recreation activity to the local economy is estimated at almost $5.7 million annually (BLM and Forest Service, 1991). In a 1987 survey asking anglers to identify their most frequently fished waters, 13.4 percent of Region 6 residents named the Snake River, 4.9 percent the South Fork Snake, and 7.5 percent Palisades Reservoir (Reid, 1989). A random survey of resident and non-resident anglers purchasing a 1994 fishing license, identified the South Fork Snake River as one of the top ten waters fished, as well as one of the most preferred (IDFG, 1995a; IDFG, 1996).

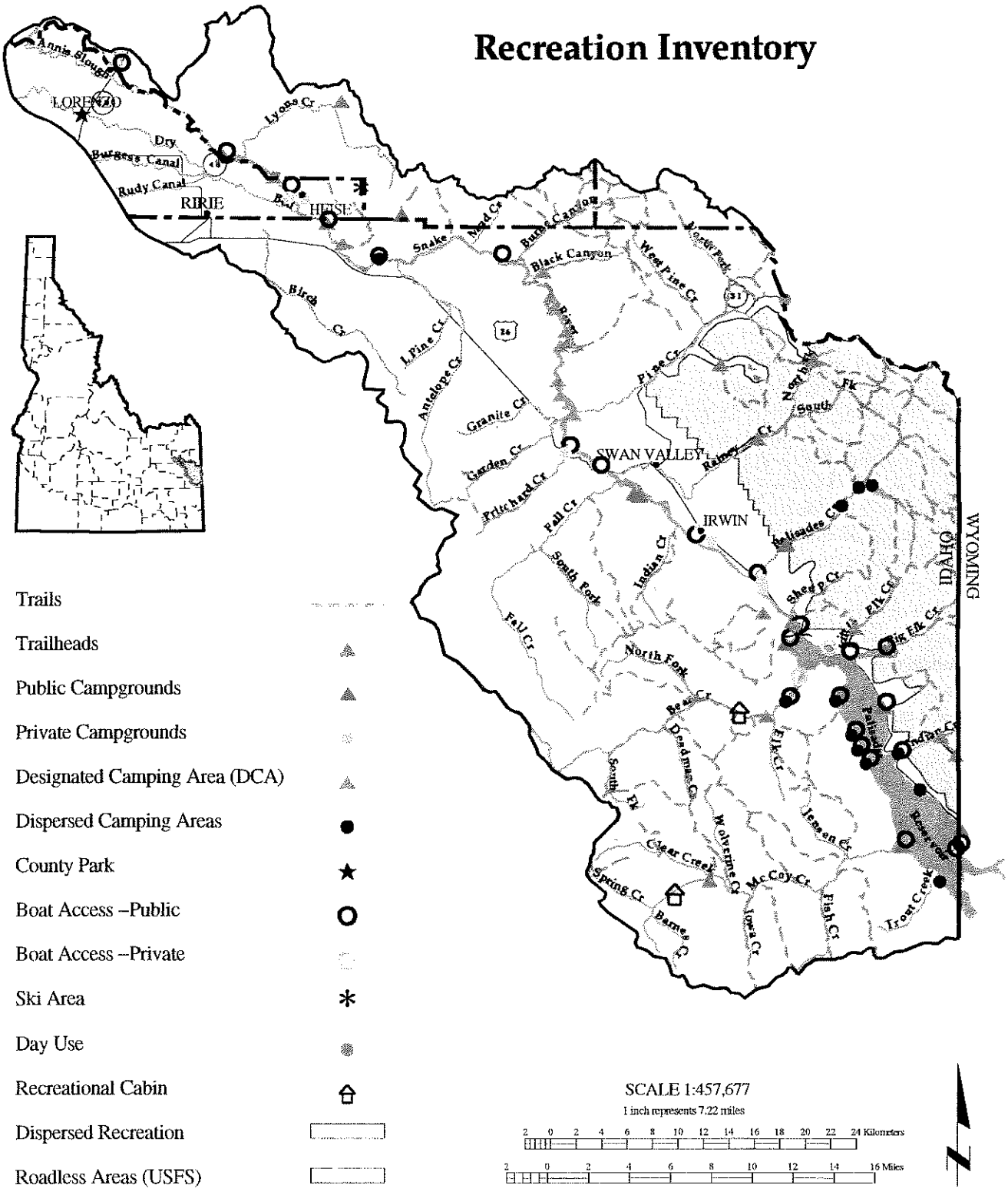
Table 20. 1995 Estimated Site Visits for BLM Managed Access Sites Along the South Fork Snake River Corridor.

Site	Visits
Conant Boat Access	36,267
Byington Boat Access	43,852
Lorenzo Boat Access(Undeveloped)	21,402
Kelly Island Campground	4,504

Source: Brown, 1996.

Figure 17

Recreation Inventory



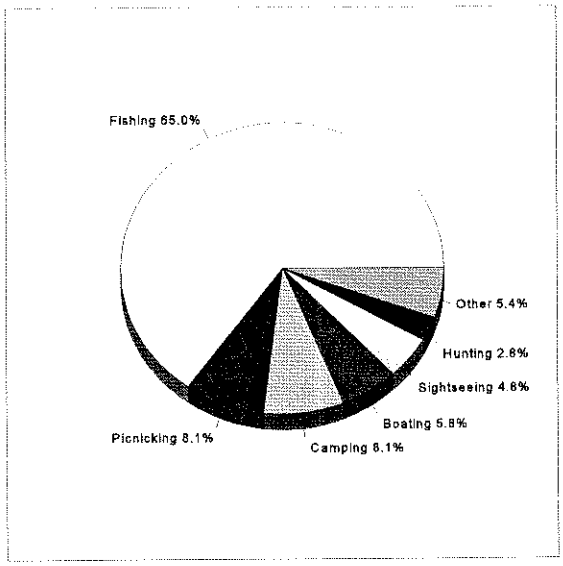


Figure 18. Composition of Recreation Activities in South Fork Snake River Corridor (Brown, 1996).

Angling use has increased significantly on the river. The IDFG estimated 89,000 angler hours on the river from March 1979 through February 1980. Based on the number of launches from the Conant boat ramp, an estimated 181,335 angler hours occurred below Conant in 1995 (Brown, 1996). Schrader (1996) estimated 169,142 angler hours during the 1996 summer season. The salmon fly hatch occurring in late June to early July results in significant angling activity for about a month.

Current IDFG management on the South Fork Snake River emphasizes a quality cutthroat trout fishery. Burns, Pine, Rainey, Pritchard, Palisades, and McCoy creeks and all other tributaries are also managed as a quality cutthroat trout fishery. Management objectives include restrictions on size and harvest of fish to achieve greater catch rates and larger "quality" size fish. These include a 2-fish limit with an 8 to 16 inch protective slot (IDFG, 1996). Harvest restrictions were initially implemented on the South Fork Snake River from Irwin to Heise gage in 1984, and extended to Palisades Dam in 1988 (IDFG, 1996). These management strategies resulted in increased size and numbers of cutthroat, and a 300 percent increase in fishing effort in 1989. The cutthroat harvest rules were implemented for the South Fork Snake River below Heise and all tributaries in 1990, and extended to all trout species on the South Fork Snake River in 1992 (IDFG, 1996).

The South Fork Snake River fishing season from Palisades Dam to the Heise stream gaging cable is open the Saturday of Memorial Day weekend through November 30. The reach below Heise is open all year. Additional restrictions apply to some important spawning tributaries. Pine Creek is closed to anglers until July 1. Burns Creek is closed until September 1.

The South Fork Snake River is also managed as a wild brown trout fishery, relying on natural production. The state record brown trout (26.4 pounds) was taken below Palisades Dam in 1981 (Martin, 1996). General management objectives are in place for whitefish with no special regulations for that species.

Many float the South Fork Snake River to view scenery and wildlife as well as to fish. Drift boats and rafts are common crafts seen on the river, as well as canoes. Personal water craft (jet skies) are also appearing on the river resulting in some conflicts among various recreation users. Motorized boating activity varies from year to year, but is estimated to range from 20-40 percent of the boating use (Brown, 1996; Taul, 1996).

Palisades Reservoir is a large reservoir with 16,100 surface acres at full pool. The reservoir is operated by the USBR, and the Targhee National Forest operates the recreation facilities. Bonneville County maintains the boat docks and has enforcement authority on the Idaho portion of the reservoir. Recreation activity consists of fishing, water skiing and camping on the shores. Several dispersed camping areas predominately accessible by boat are popular camping spots. Because the reservoir has such a large surface area, congested areas on the reservoir have not been a concern in the past, although some boat ramps receive heavy use.

Eight outfitters provide fishing trips on the South Fork Snake, operating from Palisades Dam to the confluence with the Henrys Fork. The

river is segmented into four sections consisting of Palisades Dam to Swan Valley Bridge, Swan Valley Bridge to Black Canyon, Black Canyon to Poplar, and Poplar to the Henrys Fork confluence. Each outfitter can operate up to four boats per day on a section, with no more than twelve boats total in a day (IOGLB rules). This would allow a maximum of 96 outfitter boats along the length of the South Fork Snake River during a day, or a maximum of 32 boats on any section.

Guided fishing trips on the South Fork Snake River have consistently been the largest component of the outfitting industry comprising 79 percent of the guide business in 1994, an increase of 24 percent from 1993 (Idaho Outfitters and Guides Licensing Board [IOGLB], 1995). In 1995, 5,877 individuals used the services of an outfitter to fish on the South Fork Snake.

Flows on the South Fork Snake River affect the ability to conduct outfitted trips. An informal survey of outfitters indicated flows of 8-10,000 cfs are ideal for guided fishing trips. The outfitters identified 15,000 cfs as a maximum flow and a minimum flow of 3,000 cfs. High and low flows limit angling success and the commercial marketability of guided trips. When flows are considered too high for successful fishing efforts, pressures increase on neighboring rivers such as the Henrys Fork as anglers look for other places to fish.

Big game hunting activity is recorded by unit number. The South Fork Snake River Basin is located mainly within Units 66, 67 and 69. Portions of Units 63A and 64 are located at the western end of the basin. These offer some of the few general bull elk hunting opportunities in southeastern Idaho, and receive heavy use (Martin, 1996). Table 21 depicts hunter days (the number of days hunters spent hunting for a given species) for big game -- deer, elk, moose and mountain goat.

Table 21. Estimated Hunter Days for Deer, Elk, Moose and Mountain Goat.

Year	Unit 63A	Unit 64	Unit 66	Unit 67	Unit 69	TOTAL
			DEER			
1990	423	4,065	6,946	5,773	11,303	**28,510**
1991	961	4,793	8,705	3,867	14,044	**32,370**
1992	135	2,844	9,386	2,476	10,157	**24,998**
1993	333	4,331	10,061	4,974	11,224	**30,923**
1994	670	585	720	778	1,840	**4,593**
			ELK			
1990	453	1,542	6,632	2,669	6,783	**18,079**
1991	845	2,386	10,651	4,681	6,863	**25,426**
1992	307	2,444	13,593	4,822	4,404	**25,570**
1993	414	2,442	14,415	5,843	5,318	**28,432**
1994	-	1,596	9,986	4,539	4,827	**20,948**
			MOOSE			
1990	38	64	46	82	110	**340**
1991	46	26	78	15	174	**339**
1992	41	32	73	18	81	**245**
1993	199	70	174	37	265	**745**
1994	104	85	106	145	121	**561**
			MOUNTAIN GOAT			
1990	-	-	-	72	-	**72**
1991	-	-	-	35	-	**35**
1992	-	-	-	48	-	**48**
1993	-	-	-	41	-	**41**
1994	-	-	-	40	-	**40**

Source: Nelson, 1990 and 1991; Kuck, 1992-1994.

SCENIC VALUES AND NATURAL FEATURES

The South Fork Snake River Basin is located in the Middle Rocky Mountain physiographic province characterized by complexly folded and faulted mountain ranges. The Snake River Range and Caribou Range dominate the eastern portion of the basin separated by a wide flat valley. The western portion of the basin occurs on the perimeter of the Snake River Plain province. The Geology and Soils section describes these geologic features in more detail.

An overview of outstanding natural areas in Idaho conducted by several state agencies identified the South Fork Snake River and its riparian forest as one of the most extensive cottonwood forests in the West (State of Idaho, 1975). In an evaluation of sites in Idaho, the South Fork Snake River received the highest rating for wildlife populations (Poccard, 1980). It has been proposed as a National Natural Landmark, because of its ecological characteristics (Johnson and Pfister, 1982). Other areas in the basin noted for distinctive scenic values include Menan Buttes, a National Natural Landmark described in the geology section of the plan, and Swan and Conant valleys.

A evaluation of the scenic values of waterways in the basin was conducted as part of the South Fork Snake River Basin Plan. The evaluation and results are presented in the *Resource Evaluation* section.

CULTURAL RESOURCES

Federal law and management policy requires assessment, survey and mitigation for potential cultural resource sites prior to implementation of federal project proposals, or actions on federal land. Although approximately 67 percent of the basin is under the jurisdiction of federal agencies, much has not been formally surveyed. Most Forest Service surveys occur in association with timber sales, but little timber harvest has occurred within this basin (Targhee National Forest, 1996a). Survey efforts have occurred as the result of USBR activities, road realignment, and range projects which have examined small areas of the South Fork Snake River drainage.

Completed surveys have identified more than 100 sites within the basin (Idaho State Historical Society, 1996). Prehistoric sites include Native American hunting camps, lithic workshops, and volcanic glass quarry sites. Many sites are historic, affiliated with mining and ranching activities, and the administration of Forest Service lands (BLM and Forest Service, 1991).

No sites are listed on the National Register of Historic Places, although many sites are eligible. The National Register is an official list maintained by the National Park Service of archaeological, historic, and architectural properties of national, state and local significance worthy of preservation. Compilation of the list was established in 1966. Known eligible sites located in the basin include: an aboriginal base camp near the Table Rock campground; a pictograph site near Warm Springs; the Heise, Brockman, Bald Mountain and Currant Creek guard stations; the Swan Valley Ranger Station; and the limekiln quarries on the Targhee National Forest (Targhee National Forest, 1996a; Willingham, 1996).

Resource Evaluation

As defined by the Idaho Code, a recreational or natural river "means a waterway which possesses outstanding fish and wildlife, recreation, geologic or aesthetic values" [Idaho Code 42-1732 (7) and (9)]. A natural river is free of substantial impoundments, dams or other structures and the riparian area is largely undeveloped. A recreational river may include some manmade development in the waterway or the riparian area. The resource evaluation is an exercise to identify rivers or streams that may be eligible for this designation. A designation is made only if the Board determines the value of preserving the waterway is in the public interest and outweighs developing the river for other beneficial uses. This determination is largely based on information received from the public

and at advisory group meetings. State designation does not change or infringe upon existing water rights or other vested property rights.

Criteria used to identify outstanding resource values for fish and wildlife, recreation, and scenic values are briefly described in the following sections. The resource evaluation criteria and results were reviewed by the advisory group, agencies and public during advisory group meetings. At that time, additional information were provided and tributaries were evaluated or reevaluated based on the new information. Table 22 summarizes the river and stream reaches identified with outstanding resource values. Figure 19 depicts the locations of these reaches.

FISH AND WILDLIFE (BIOLOGICAL)

The biological evaluation for the South Fork Snake River Basin considered the entire watershed of a stream reach. This procedure represents a combination of several different stream assessment methodologies, including the EPA Rapid Bioassessment Protocols (RBP) and Streamwalk, the DEQ's Beneficial Use Reconnaissance Procedure (BURP), and IDFG's Idaho Rivers Information System (IRIS) among others. There were twenty-six streams or reaches evaluated in the basin. All these streams had some biological information about them available, but it may not be sufficient to evaluate the resource value. The evaluation consisted of a two step procedure: 1) *River Biological Screening Process*---an initial screening to determine eligibility, and 2) *Crucial Species and Habitats*---a final evaluation of the basin's unique species and their habitats.

Criteria

River Biological Screening Process

Biological data were collected from various sources, including IDFG, Targhee National Forest, Idaho Falls District BLM, IDWR field surveys, and specific research studies. The data were compiled for twenty biological attributes on each stream (Table 23, page 64). These twenty attributes were categorized into four components to help collect and organize the data:

1. ***Habitat: Aquatic***- physical conditions and water quality associated with the water in the stream channel;
2. ***Habitat: Riparian***- physical conditions and vegetation community characteristics in the floodplain;
3. ***Species: Aquatic*** - plant and animal species associated with the water in the stream channel;
4. ***Species: Riparian*** - plant and animal species in the floodplain.

Based on available data, each stream was evaluated for the number of attributes that were positive. An attribute was considered positive if the data indicated the characteristic contributed positively to the quality of the habitat.

Crucial Species and Habitats

Based on the available information for several identified key species, species complexes, and habitats in the South Fork Snake River Basin, reaches were also assessed for presence and current status of crucial species and habitats. These "key" species or habitats were selected on the basis of ecological importance as noted by biologists. These species and habitats include the following:

- Unique riparian ecosystem (cottonwood *Populus angustifolia* gallery forest; or spring-fed system)
- Yellowstone cutthroat trout (*Oncorhynchus clarki Bavaria*)
- Fine-spotted cutthroat trout (*Oncorhynchus clarki* ssp.)
- Bald eagle (*Haliaeetus leucocephalus*)
- Breeding birds (predominately land birds, few water birds)

Results

Both components of the evaluation were considered to determine if a reach possessed outstanding biological values. Reaches with outstanding biological values fulfilled the following criteria:

Table 22. Summary of Outstanding Resource Evaluation for the South Fork Snake River Basin.

STREAM REACH	FISH & WILDLIFE	SCENIC	RECREATION
Bear Creek	✘+		✘
Big Elk Creek			
State line to T1S, R46E, NW ½ Sec. 17	✘	✘	✘
T1S, R46E, NW ½ Sec. 17 to high water of reservoir	✘		✘
Black Canyon	✘		✘
Burns Creek (tributary to Palisades Reservoir)	✘		✘
Burns Creek (tributary to main stem)	✘+	✘	✘
Cress Creek	✘	✘	✘
Elk Creek (tributary to Bear Creek)	✘		✘
Fall Creek			
Headwaters to Forest Road 058	✘+		✘
Forest Road 058 to mouth	✘+	✘	✘
Indian Creek (tributary to Palisades Reservoir)	✘		
Indian Creek (tributary to main stem)	✘		✘
Iowa Creek (tributary to McCoy Creek)	✘		✘
Jensen Creek (tributary to McCoy Creek)	✘		✘
Little Elk Creek			✘
Little Kelly			
Headwaters to T4N, R41E, NW ½ Sec. 29		✘	
McCoy Creek	✘+		✘
Mike Spencer Canyon			✘
Palisades Creek			
Headwaters to Palisades Campground	✘+	✘	✘
Palisades Campground to mouth	✘		
Pine Creek			
Headwaters to No Cut Timber Canyon	✘+		
No Cut Timber Canyon to Mouth	✘+	✘	
Pine Creek, North Fork	✘+		✘
Pine Creek, West Fork	✘+		✘
Pritchard Creek			
Headwaters to BLM Boundary	✘		✘
BLM Boundary to mouth	✘		
Rainey Creek			
Headwaters to Forest boundary	✘+		✘
Forest boundary to mouth	✘+		
Sheep Creek			✘
South Fork Snake River			
State line to confluence of Salt and South Fork Snake rivers	✘		✘
Confluence of Salt and South Fork Snake rivers to Palisades Dam	✘	✘	✘
Palisades Dam to Irwin footbridge	✘		✘
Irwin footbridge to Henrys Fork confluence	✘	✘	✘
Tie Creek (tributary to Pine Creek)	✘		
Trout Creek	✘+		✘
Warm Springs	✘		
Waterfall Canyon	✘	✘	✘
Wolverine Creek	✘		✘

✘ = Stream reach evaluated as having outstanding resource values for the resource indicated.
✘+ = Includes perennial tributaries.

Figure 19

Waterways with Outstanding Resource Values

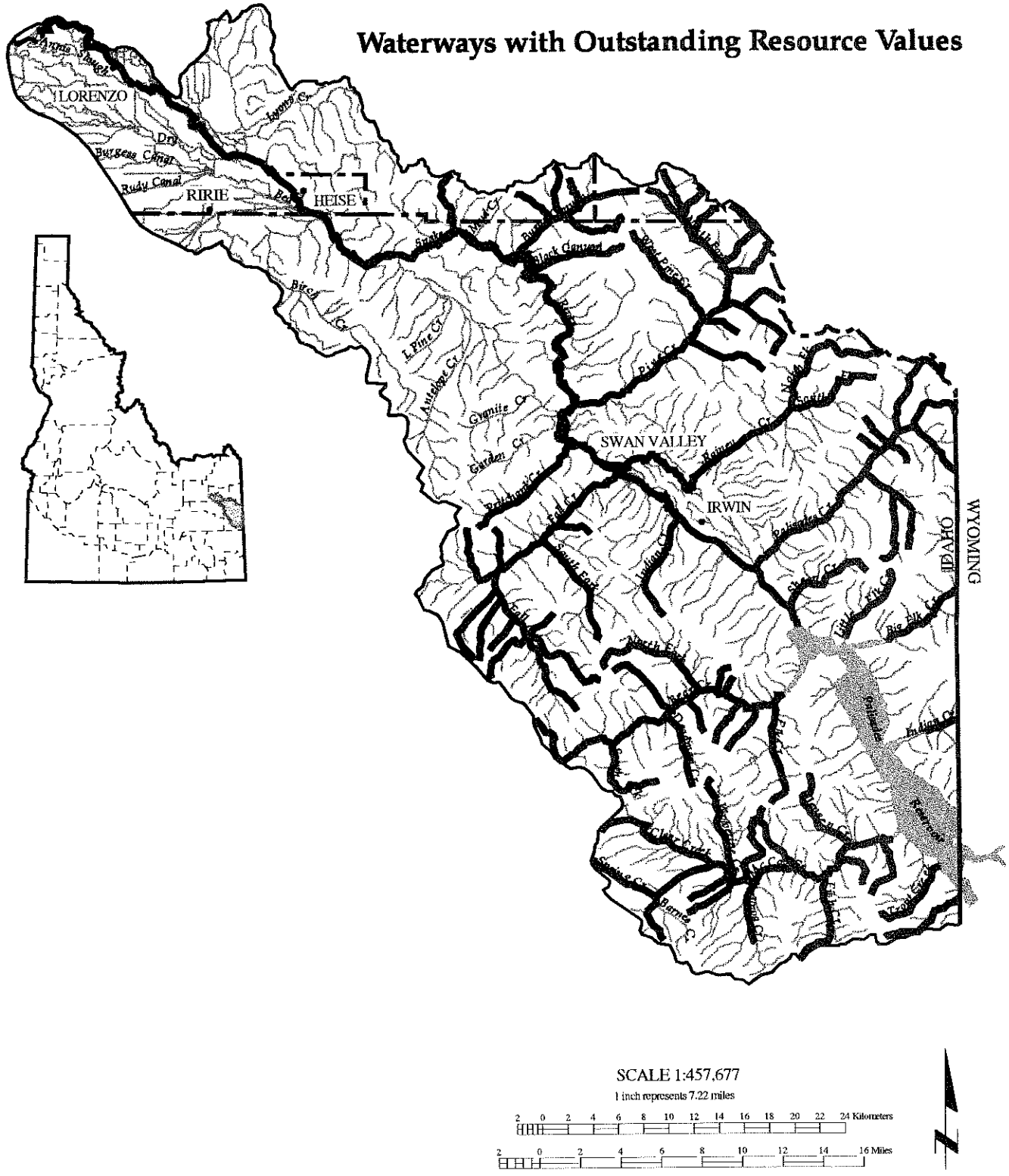


Table 23. River Biological Screening Process Criteria

HABITAT--Aquatic

1. Bottom substrate type (observe in channel-forming pool tail-outs [at least 1/3 of stream width] and low gradient riffles): cobble and boulders dominant; fine sediment not dominant
2. Instream cover: large woody debris and/or undercut bank
3. Instream habitat: complexity of stream channel habitats present (riffles [or bends], runs, pools)
4. Water quality: at least one of the following DEQ classifications apply to study reach :
   - Meets all beneficial uses
   - Water quality criteria/standards satisfied
   - Outstanding Resource Water
   - Special Resource Water
5. Crucial spawning habitat

HABITAT--Riparian

6. Bank stability: vegetation canopy and roots cover majority of bank and no slumping or eroding occurs
7. Riparian vegetation cover: dominated by shrubs and/or trees
8. Special management areas:
   - Area of Critical Environmental Concern
   - Pioneer Area
   - Priority Wetlands
   - Research Natural Area
   - Recovery Area
   - Special Interest Botanical Area
   - Wild & Scenic River or eligible
   - Wildlife Refuge
   - Wildlife Management Area
   - Wilderness Area or proposed

Crucial wildlife habitat:

9. wintering
10. migratory/roosting

SPECIES--Aquatic

11. IDFG fishery management classification; at least one of the following IDFG fishery classifications applies to study reach:
    - Trophy
    - Preservation
    - Quality
    - Wild Trout
    - Anadromous
12. Fish species richness: diversity (no. species with balanced abundances) relatively high
13. Fish species composition: predominantly native or game species
14. Aquatic insect composition: predominantly species of low pollution/sediment tolerance (e.g., mayflies, stoneflies, caddisflies, etc.)

Rare aquatic biota:

15. Federal listed species
16. Conservation Data Center listed species

SPECIES--Riparian

17. Riparian species richness: diversity (total no. species with balanced abundances) relatively high
18. Riparian species composition: predominantly native species

Rare riparian biota:

19. Federal listed species
20. Conservation Data Center listed species

- at least 50 percent of the available data was positive (all reaches evaluated met this criteria); and

- the presence of at least one of the following crucial habitats or sensitive species: unique riparian ecosystem, active cutthroat spawning or rearing, active eagle nesting, or unusually high breeding bird diversity.

Reaches identified with biologically outstanding values using these criteria are summarized in Table 24.

RECREATION EVALUATION

The recreation evaluation focused on recreational opportunities occurring within specific river or stream reaches. The evaluation entailed identification of recreation units; analysis

Table 24. Summary of Outstanding Biological Resources for Stream Reaches in the South Fork Snake River Basin.

REACH	River Biological Screening Process[1]	Crucial Species and Habitats[2]	Outstanding Biological Values
Burns cr. (res trib)	18/20	√	Spawning tributary with good population of cutthroat trout; bald eagle foraging habitat
Trout Cr.	16/20	√	Spawning tributary with good population of cutthroat trout
McCoy Cr. (incl. Fish Cr.. & other perennial trib.)	10/16	√	Important spawning tributary with strong population of cutthroat trout; bald eagle foraging habitat
Bear Cr. (incl. Elk Cr. and other perennial tributaries)	12/18	√	Important spawning tributary with strong population of cutthroat trout; bald eagle foraging habitat
Indian Cr. (res tributary)	16/20	√	Spawning tributary with good population of cutthroat trout
Big Elk Cr.	17/20	√	Spawning tributary with good population of cutthroat trout; bald eagle foraging habitat, kokanee spawning
Little Elk Cr.	10/10		
Palisades Cr. (incl. headwaters trib., perennial trib..)	12/16	√	Important spawning tributary with strong population of cutthroat trout; bald eagle foraging habitat
Indian Cr. (river trib)	9/11	√	Spawning tributary with good population of cutthroat trout
Fall Cr. (incl. perennial trib.)	`9/14	√	Disjunct population of cutthroat
Rainey Cr. (inc. perennial trib..)	7/11	√	Important potential spawning tributary with good population of cutthroat trout; bald eagle foraging
Pritchard Cr.	7/11	√	Spawning tributary with good population of cutthroat trout
Pine Cr. (incl. West & North Pine Cr, Tie Cr., and other perennial trib.)	10/15	√	Important spawning tributary with strong population of cutthroat trout; bald eagle foraging habitat
Black Canyon	17/20	√	Spawning tributary with good population of cutthroat trout
Warm Springs Cr.	16/20	√	Spawning tributary with good population of cutthroat trout; unique spring-fed aquatic community and riparian cottonwood gallery forest with good structural diversity; bald eagle foraging habitat
Burns Cr. (incl. perennial trib.)	15/20	√	Important spawning tributary with strong population of cutthroat trout; mature, healthy riparian community with good structural and species diversity; bald eagle foraging
Wolverine Cr.	16/20	√	Spawning tributary with good population of cutthroat trout; bald eagle foraging habitat
Antelope Cr.	6/11		
Cress Cr.	10/14	√	Unique spring-fed riparian community with good structural diversity
Palisades Reservoir	11/11	√	Bald eagle nesting
S Fk Snake R: Palisades Dam to Irwin	14/18	√	Bald eagle nesting; important cutthroat trout rearing habitat
South Fork Snake R: Irwin to Conant Valley (Granite Cr.)	15/17	√	Bald eagle nesting; above average breeding bird diversity; important cutthroat trout rearing habitat, mature, healthy riparian community with good structural and species diversity
South Fork Snake R: Conant Valley to Black Canyon	15/17	√	Bald eagle nesting; above average breeding bird diversity; important cutthroat trout rearing habitat, mature, healthy riparian community with good structural and species diversity
South Fork Snake R: Black Canyon to Heise gaging station	13/17	√	Bald eagle nesting; mature, healthy cottonwood gallery forest; above average breeding bird diversity; important cutthroat trout rearing habitat
South Fork Snake R: Heise gage station to Heise Br	10/16	√	Bald eagles perching;;mature, healthy cottonwood gallery forest; important cutthroat trout rearing habitat
South Fork Snake R: Heise Br to Henry's Fork confluence	16/18	√	Bald eagle nesting; mature, healthy cottonwood gallery forest; important cutthroat trout rearing habitat

[1] = Total no. of positive attributes / Data available of maximum 20 attributes [2] = ✓indicates presence of crucial species or habitat

of the recreational diversity and importance of each recreation unit; and categorization of a final evaluation value for each unit (outstanding, high, or moderate to low).

The river reaches within the South Fork Snake River Basin were grouped into segments or discrete recreation units delineated on the basis of land use patterns, access and/or recreational use patterns. Each recreation unit was individually evaluated for recreational diversity and the importance of recreational opportunities. Specific recreational features of these units are summarized in evaluation forms located in IDWR files.

Recreational diversity is a measure of the variety of recreational opportunities available in the recreation unit. Three criteria were assessed to arrive at a diversity value: 1) identification of land-based and water-based recreation opportunities, 2) natural features, and 3) level of access.

Land-based and water-based recreation activities occurring within the river corridor were identified through review of agency documents and maps describing recreation facilities, and communications with various agencies and user groups. Land-based activities include camping, hiking, or hunting. Water-based recreation includes fishing, swimming and boating.

Natural features were identified which enhance recreation opportunities or experiences. These include description of water characteristics influencing the type of boating activity possible; summary of the aesthetic values of the unit; and identification of special fish and wildlife habitat characteristics providing increased opportunity for wildlife observation or other wildlife-related recreation.

Level of access was described to provide information regarding the types of recreational activities possible, potential use volume, and opportunities for primitive or isolated versus a more developed recreation experience.

Recreational importance was determined through review of three criteria: 1) unique or rare features which may enhance the recreation experience such as high quality fisheries or wildlife habitat; 2) public concern for the recreational values of the unit (determined from public and advisory group input, and agency consultation; and 3) special designations and/or agency recreation management objectives.

The final recreation evaluation class for each recreation unit was based on a combined assessment of diversity and importance.

A recreation unit evaluated as outstanding: a) provides significant recreation opportunities encompassing a great diversity of activities; b) provides a unique or rare experience within the region or basin; and/or c) receives the highest use.

A recreation unit evaluated as high is characterized by river segments: a) receiving high use; b) providing a high diversity of recreational opportunities; and/or c) providing an important recreation experience which is unique but typical for the region.

Moderate to low designations define those river segments with: a) recreational opportunities typical in the region; b) receiving moderate to low use; and/or c) having moderate to low recreation diversity.

Table 25 (pages 68 and 69) summarizes the recreation evaluation for river reaches evaluated in the South Fork Snake River Basin. The evaluation focused on the main stem of the South Fork Snake River and thirty major tributaries. Many stream reaches in the basin lacked sufficient data to evaluate recreation opportunities and were not evaluated.

SCENIC VALUES EVALUATION

The objective of the scenic values evaluation was to determine the distinctiveness or scenic quality of landscape settings. The evaluation involved two steps. One was to categorize landscapes along stream reaches into individual visual units. The second was to evaluate the scenic distinction or aesthetic value of these

visual units to identify outstanding scenic landscapes.

Delineating Visual Units

A visual unit defines a landscape area with similar spatial characteristics such as landform, vegetation, water form, or cultural modifications (Tetlow and Sheppard, 1980). Noticeable changes in these characteristics significantly changing the viewing experience defines the boundary between visual units. Visual units provide a frame of reference to later evaluate the scenic value of landscape features.

Visual unit boundaries were determined by considering a river or stream as a linear viewing corridor or series of viewing experiences. The outermost boundary of the unit is defined by the edge of canyon walls, or the extent of the viewshed. Any distinct or conspicuous change in landscape elements significantly changing the viewing experience as one progressed along the corridor marks the boundary between visual units. In the South Fork Snake River Basin, visual unit boundaries generally indicate changes in the stream pattern or water characteristics (i.e., free flowing water versus reservoirs, single channel versus braided, or flowing versus cascading); differences in canyon wall scale and enclosure; presence of unique landforms; changes in density and types of vegetation patterns; and/or changes in the degree or type of land use patterns.

Visual unit boundaries were delineated during site visits conducted from 1993 to 1995. Information was recorded on maps and through photography. Forms were also completed in the field and later photographic documentation reviewed to record landform, vegetation, water character, cultural modifications and other characteristics for each unit. Boundaries were drawn on 7.5 minute U.S. Geological Survey quadrangle maps and checked against orthophotoquads to verify accuracy.

The scenic evaluation focused on the main stem of the South Fork Snake River and major tributaries. Of the sixteen streams evaluated for scenic values, sixty-nine visual units were identified. Not all tributaries were evaluated, especially if access was difficult. The entire tributary was not evaluated if time did not allow access to the entire stream. This was the case for the headwaters of several streams. Streams that extended into Wyoming were only evaluated for scenic values within Idaho.

Scenic Distinction Evaluation

Each visual unit was evaluated for scenic distinction. Scenic distinction is a measure of the aesthetic quality of a landscape from a regional perspective. This evaluation must consider the landscape features within the context of the region or physiographic province that it occurs. Therefore, landscape elements for the South Fork Snake River Basin are evaluated relative to typical landscape features in Eastern Idaho and not Northern Idaho.

The Forest Service and BLM have established procedures for measuring the aesthetic quality of landscapes (BLM, 1986; Forest Service, 1974). Scenic distinction for the South Fork Snake River Basin used the scoring presented in Table 26, page 70. This table was developed by the BLM for use in evaluating scenic quality of public lands, and uses criteria similar to the Forest Service system. The model assesses the degree of variety a landscape possesses. The premise behind this chart is that all landscapes have scenic value, but areas with the most variety or harmonious composition have the greatest value (BLM, 1986; Forest Service, 1974).

The degree of visual variety and harmonious composition of seven factors (landform, vegetation, water, color, adjacent scenery, scarcity and cultural modifications) is evaluated using a numeric rating system. Each component comprising the landscape is evaluated individually, using a value of one to five (with the exception of cultural modifications which are rated -4 to 2) to rate the amount of variety,

Table 25. Recreation Evaluation Criteria and Results for the South Fork Snake River Basin.

Outstanding Significant recreational opportunities available as indicated by a great diversity of activities; unique or rare experience; and/or highest use areas.	**Bear Creek** *(Headwaters to high water of reservoir)* - significant diversity of recreational opportunities; one of the few areas in the state to participate in general bull elk hunting **Big Elk Creek** *(State line to high water of reservoir)* - unique opportunity to observe and fish for kokanee; one of the few areas in the state to participate in general bull elk hunting **Black Canyon** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting **Burns Creek** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting; high motorized use trail **Cress Creek** *(Headwaters to mouth)* - high quality spring-fed stream ecosystem providing unique education opportunities to the area; high use which is increasing yearly **Elk Creek** *(headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting **Fall Creek** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting; highest hunter densities in the basin **Indian Creek** *(Tributary to main stem)* - one of the few areas in the state to participate in general bull elk hunting **Iowa Creek** *(Tributary to McCoy Creek)* - Historic mining town, Caribou City, determined eligible for the National Register, planned for interpretation **Jensen Creek** *(Tributary to McCoy Creek)* - one of the few areas in the state to participate in general bull elk hunting **Little Elk Creek** *(headwaters to mouth)* - one of the few places in Idaho to hunt mountain goat; one of the few areas in the state to participate in general bull elk hunting; **McCoy Creek** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting; highest fishing pressure of all tributaries in the basin **Mike Spencer Canyon** *(Tributary to Pine Creek)* - one of the few areas in the state to participate in general bull elk hunting **Palisades Creek** *(Headwaters to Palisades Creek Campground)* - unique opportunities -- easy access to high mountain lakes; wilderness setting; high use National Recreational Trail; one of the few areas in the state to participate in general bull elk hunting **Pine Creek, North and West Forks** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting **Pritchard Creek** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting in a isolated setting **Rainey Creek** *(Headwaters to Forest boundary)* - one of the few areas in the state to participate in general bull elk hunting **South Fork Snake River (Palisades Reservoir)** *(State line to dam)* - significant diversity of recreational opportunities; highest use destination reservoir in the state **South Fork Snake River** *(Palisades Dam to confluence with Henrys Fork)* - unique quality fishing opportunities which attract people nationally; fishing opportunities in both a roaded and unroaded setting; one of the few areas in the state to participate in general bull elk hunting **Sheep Creek** *(Headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting **Trout Creek** *(Tributary to Palisades Reservoir)* - one of the few areas in the state to participate in general bull elk hunting **Waterfall Canyon** *(Tributary to Palisades Creek)* - Waterfalls, one of the few areas in the state to participate in general bull elk hunting **Wolverine Creek** *(headwaters to mouth)* - one of the few areas in the state to participate in general bull elk hunting

High River segments with a high use volume; high diversity; and/or a recreation opportunity which is unique but typical in the region.	None identified
Moderate and Low River segments with moderate to low use volume; moderate to low diversity of opportunities; and/or providing recreational opportunities typical and abundant within the region.	**Antelope Creek** *(Headwaters to mouth)* - moderate to low diversity of recreational opportunities **Indian Creek** *(tributary to reservoir)* - moderate/low diversity of recreational opportunities **Kelly Creek** *(Headwaters to mouth)* - moderate rating for uniqueness because of ski opportunities; moderate/low diversity of recreational opportunities **Little Keily Creek** *(Headwaters to mouth)* - moderate diversity of recreational opportunities **Palisades Creek** *(Palisades campground to mouth)* - low diversity of recreational opportunities on private land **Pine Creek** *(Headwaters to Forest boundary* - moderate diversity of recreational opportunities **Pine Creek** *(Forest boundary to mouth)* - moderate/low diversity of recreational opportunities because of difficult access **Rainey Creek** *(Forest Boundary to mouth)* - moderate to low diversity of recreational opportunities **Sheep Creek** *(Headwaters to mouth)* - moderate diversity of recreational opportunities

contrast, harmony, or distinctiveness within the unit -- the higher the rating, the greater the variety or more distinctive the feature. Several factors are considered when evaluating these individual landscape features and are described below.

Landform - This component considers variation in topography. The more variation in topography the more interesting. Land forms perceived as outstanding or distinctive are steep, massive, severely eroded or sculpted, or have interesting rock formations and outcrops.

Vegetation - Evaluating the vegetation component of the landscape requires consideration of variety in patterns, forms and textures of plant material. Landscapes with several plant communities are usually considered more interesting than landscapes characterized by one type. The variety or diversity of plant material in an individual plant community is also considered.

Color - Color is evaluated with respect to harmony, vividness and contrast in the landscape setting. In the South Fork Snake River Canyon, the vivid green of vegetation provides a pleasing contrast against the dark basalt of the cliffs. Landscapes with muted colors or monotonous color schemes are rated lower. It is important to consider seasonal variations such as peak autumn color and wildflower displays.

Water form - Water is an ingredient that adds movement or serenity to a scene. The degree that water dominates the scene is the key in rating its contribution to the scenic value of the landscape. Studies in which observers are asked to rate the quality of the scenery have consistently found that scenes with water are always rated higher than scenes without. This makes it more difficult to differentiate scenic values for a river basin study when water is present in all landscapes. The primary criterion is movement or dominance of water in the landscape. While water within the canyon would tend to dominate the desert landscape, in the context of the South Fork Snake River Canyon slow moving water (typically found in reservoirs) would be considered less interesting than water characterized by more visible movement such as rapids and falls, or with interesting patterns such as braiding or extensive meanders.

Table 26. Scenic Distinction Evaluation Criteria

LANDFORM	High vertical relief; severe surface variation; detail features dominant 5	Steep canyons; variety in shape and pattern of landforms; detail features not dominant 3	Low rolling hills; flat valley bottoms; few or no interesting land features 1
VEGETATION	Variety of vegetation types in interesting forms, textures, and patterns 5	Some variety in vegetation, but only one or two major types 3	Little or no variety in vegetation 1
WATER	Clear and clean; cascading whitewater; dominant feature in landscape 5	Flowing or still, but not dominant in landscape 3	Absent, or present but slack water or slow moving 0
COLOR	Rich color combination; vivid color; pleasing color contrasts 5	Some intensity or variety in color and contrast, but not dominant element 3	Subtle color variations or contrasts; generally mute tones 1
ADJACENT SCENERY	Adjacent scenery greatly enhances visual quality 5	Adjacent scenery moderately enhances overall visual quality 3	Adjacent scenery has little or no influence on overall visual quality 0
SCARCITY	Very rare in region; consistent chance for exceptional wildlife, wildflower viewing, etc. 5	Distinctive, although somewhat similar to others in the region 3	Interesting within its setting, but fairly common within the region 1
CULTURAL MODIFICATIONS	Modifications add favorable to visual variety while promoting visual harmony 2	Modifications add little or no visual variety and introduce no discordant elements 0	Modifications add variety but are very discordant and promote strong disharmony -4

SOURCE: BLM, 1986.

Adjacent scenery - The influence of adjacent scenery can be an important consideration for landscape settings which by themselves are not considered to have high scenic value, but provide a frame for some spectacular adjacent scenery.

Scarcity - Landscape scarcity considers situations where a number of not so spectacular elements in an unusual or unique combination may produce a memorable scene, or gives added value to unique features that are rare such as plant communities or geological features.

Cultural modifications - Alterations to the landscape may detract from the scenery, but also may enhance. For example, studies in Arizona showed that agricultural landscapes were rated higher for scenic value than the natural creosote flatlands. The key is whether the development is harmonious using materials that blend with the landscape or contrast in a positive way. A cultural modification that would be considered to be positive would use materials that mimiccolors, textures, form and line found in the surrounding landscape setting. Agricultural settings tend to enhance the scenic value of some landscapes.

Using these concepts, a scenic distinction evaluation was completed for each visual unit identified in the South Fork Snake River Basin. A narrative description of each element was prepared and each element given a numerical rating. A final rating is derived by totaling the scores for all seven landscape features. This score determines the scenic distinction category:

class A = outstanding - scores of 32 to 19
class B = high - scores of 18 to 12
class C = moderate/low - scores of 11 or less

Table 27 describes the scenic distinction evaluation results for the South Fork Snake River Basin. Evaluation forms (available in IDWR files) describe the landscape features and document the scoring for each visual unit.

Table 27. Results of the Scenic Evaluation for the South Fork Snake River Basin.

SCENIC DISTINCTION CATEGORY	STREAM REACH
Class A = Outstanding Landscapes with significant variety in landscape features; and/or possessing distinctive or unique, rare features (received a score of 32 to 19).	South Fork Snake River (Confluence of Salt and South Fork Snake rivers to Palisades Dam; one-mile west of Idaho-Wyoming state line) South Fork Snake River (Irwin footbridge to Henrys Fork confluence) Big Elk Creek (State line to T 1 S, R 46 E, NW ½ of Sec. 17) Burns Creek (T 4 N, R 43 E, SE 1/4 of Sec. 28 to Beartrap Canyon Cress Creek Fall Creek (Forest Road 058 to mouth) Little Kelly Creek (Headwaters to T 4 N, R 41 E, NW ½ of Sec. 29) Palisades Creek (Headwaters to Palisades Creek campground) Pine Creek (No Cut Timber Canyon to mouth) Waterfall Canyon
Class B = High Landscapes with moderate variety in landscape features (received a score of 18 to 12).	South Fork Snake River (Palisades Dam to Irwin footbridge) Antelope Creek Bear Creek Big Elk Creek (T 1 S, R 46 E, NW ½ of Sec. 17 to mouth) Fall Creek Indian Creek (reservoir tributary) Kelly Creek (Kelly Ski Area to Little Kelly Creek confluence) Little Kelly Creek (T 4 N, R 41 E, NW ½ of Sec. 29 to mouth) Lyons Creek (Headwaters to T 4 N, R 41 E, SE 1/4 of Sec. 5) Lyons Creek (Herbert to T 4 N, R 40 E, SE 1/4 of Sec. 10) McCoy Creek Palisades Creek (Palisades Creek campground to Highway 26) Pine Creek (North Fork Pine Creek confluence to No Cut Timber Canyon) Rainey Creek Sheep Creek
Class C = Moderate to Low Landscapes where characteristic features possess little variety (received a score of 11 or less).	South Fork Snake River (State line to Salt and South Fork Snake rivers confluence) Kelly Creek (Headwaters to Kelly Ski Area) Kelly Creek (Little Kelly Creek confluence to mouth) Lyons Creek (T 4 N, R 41 E, SE 1/4 of Sec. 5 to Herbert) Lyons Creek (T 4 N, R 40 E, SE 1/4 of Sec. 10 to Bench) Pine Creek (Headwaters to North Fork Pine Creek confluence)

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